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AIRCRAFT NAVIGATION AND LANDING TECHNOLOGY: STATUS OF IMPLEMENTATION

HEARING

BEFORE THE

SUBCOMMITTEE ON TRANSPORTATION, AVIATION AND MATERIALS

OF THE

COMMITTEE ON SCIENCE AND TECHNOLOGY U.S. HOUSE OF REPRESENTATIVES

NINETY-EIGHTH CONGRESS

SECOND SESSION

JULY 24, 1984

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CONTENTS

WITNESSES

July 24, 1984:

Page

Donald L. Miller, vice president, navigational aids systems, Hazeltine Corp.; accompanied by Richard F. Frazita, technical director, Hazeltine Corp.; Larry J. Bowe, Sperry Corp., Flight Systems; accompanied by Ernie Islava, manager, airline flight operations support, Sperry Corp.; and John W. Sandford, president and chief executive officer, the De Haviland Aircraft of Canada, Ltd.; accompanied by R. Keith Williamson, supervisor, special projects, the De Haviland Aircraft of Canada, Ltd 3

Frank L. Jensen, Jr., executive director, Helicopter Association International; Robert T. Warner, senior vice president, government and public affairs, Aircraft Owners and Pilots Association; Robert A. Cooke, vice president, operations, National Business Aircraft Association; accompanied by Myron W. Collier, manager, flight operations, Cyclops Corp.; and Gilbert F. Quinby, principal, G. F. Quinby Associates; John O'Brien, director, engineering and air safety department, Air Line Pilots Association; accompanied by Tom Kramer, vice chairman of operations, Air Traffic Control Committee; and J. Dawson Ransome, chairman and president, Ransome Airlines; accompanied by Frank Foster, chief pilot, Ransome Airlines; and Dan Santor, special assistant to vice president operations 93

John Kern, Deputy Director, Office of Flight Operations, Federal Aviation Administration; accompanied by Marty Pozesky, Director of the Program Maintenance and Engineering Service; and Will Reazin, Manager of the Air Traffic Procedures Division, Air Traffic Service 178

AIRCRAFT NAVIGATION AND LANDING TECHNOLOGY: STATUS OF IMPLEMENTATION

TUESDAY, JULY 24, 1984

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
SUBCOMMITTEE ON TRANSPORTATION, AVIATION,
AND MATERIALS,
Washington, DC.

The subcommittee met, pursuant to call, at 9:40 a.m., in room 2325, Rayburn House Office Building, Hon. Dan Glickman (chairman of the subcommittee) presiding.

Mr. GLICKMAN. Good morning.

Today the subcommittee will begin 2 days of hearings on some of the most critical safety issues facing air travelers today. Our first day will focus on the increasingly crowded air traffic system, along with some of the technical ways of dealing with this problem without compromising safety.

Congestion has received considerable attention of late because, up to now, the FAA has chosen to deal with it by holding aircraft on the ground. Last month, for example, nearly one in five scheduled departures out of New York's three major airports was delayed by 15 minutes or more. Nationwide, these delays have increased 73 percent over last year and delays of up to several hours are becoming increasingly common.

Furthermore, I fear that this trend will only grow worse in the months to come because air travel is expected to set new records in 1984. Not only has traffic increased, but more of these flights are being crowded into a few time slots.

I might just parenthetically say that a couple of weeks ago when I was flying back to Wichita through Chicago, my United flight from Chicago to Wichita left at 6:44 and if you looked at the screen, there must have been 20 or 30 United flights all within about a 4-minute time period. Obviously, not all of those could get off the ground at the same time and I assume that American, Delta, and United also had flights during that same period of time, so—and needless to say, the traffic delays were enormous because there was no way you can get that traffic out of there within that short period of time.

Controllers are complaining of overwork and raising concerns about safety because they are handling 8 percent more flights today than before the PATCO strike. Also, deregulation has changed the way airlines do business today. Major airlines have adopted hub-and-spoke route systems, resulting in the scheduling of

as many as 40 flights at the same time at major airports to accommodate passengers wanting to make connections.

In addition, many new regional commuter airlines have emerged to meet the demands of the smaller cities. Clearly, we need to increase the capacity of our air traffic system.

This subcommittee authorized the FAA's plans for modernizing the airspace system—the NAS plan—and has consistently supported its implementation. We have a particular interest in seeing that advanced technology, such as area navigation, the microwave landing system and short takeoff and landing aircraft—that all of these are used to improve the safety and efficiency of the air traffic system. And yet, they have remained essentially on the shelf for many years.

The question we wish to ask is "Why?" Why isn't the FAA and the industry moving more rapidly when the need for greater airport and airway capacity is so obvious?

This morning, we will hear from two panels representing both the equipment manufacturers and the users, as well as the FAA. I look forward to a very productive hearing and I want to thank the expert witnesses who have agreed to testify here this morning.

Mr. Carney will be here shortly. Without objection, his statement will appear in the record.

[The prepared statement of Mr. Carney follows:]

OPENING STATEMENT OF HON. WILLIAM CARNEY

Thank you, Mr. Chairman, the capacity of our airspace system is of continuing interest to those of us who have to use it regularly. And while specific forecasts of air traffic growth might be questioned, we can all agree that over time the demand of the system will continue to grow. And with this growth comes problems—congestion—noise—and a potential loss in safety.

Deregulation has resulted in many more airlines wanting to fly into the same cities at the same time. Since 1978 the number of scheduled interstate airlines has increased from 36 to 123. The hub and spoke operations which have resulted from deregulation have also contributed to airport congestion.

We don't have to look far to see the impact of this growth. Our own National Airport illustrates the problems of a busy metropolitan airport. Local residents complain of the noise, developers continue to surround the airports with high-rises while occupants of those high-rises complain of the hazards, and travelers continue to opt for the convenience of a downtown airport over the long commute to the less congested out-lying facilites.

To what extent can the technologies which we will be addressing today alleviate some of these problems? Attempts to make more efficient use of existing airports without compromising safety have met with some success through the use of area navigation and STOL aircraft, and with increased use of microwave landing systems we can look forward to even greater improvements.

Thank you, Mr. Chairman, for inviting these expert witnesses here today to enlighten us on their plans for utilizing these technologies and advising us of any problems they might foresee.

I look forward to hearing their testimony and I join you in welcoming all our distinguished witnesses here this morning.

Mr. GLICKMAN. And Mr. McCandless, do you have any thoughts? You come from perhaps potentially the most congested air traffic area in the world.

Mr. MCCANDLESS. Thank you, Mr. Chairman. No, I have no questions or statements at this time.

Mr. GLICKMAN. Thank you very much.

OK, our first panel is manufacturers who are involved in the development of techniques that hopefully could help take care of this

problem: Mr. Donald Miller, vice president, with Hazeltine Corp.; Mr. Larry Bowe, with Sperry; and Mr. John Sandford with de Haviland of Canada.

Why don't we start with Mr. Miller and we will go to Mr. Bowe and then to Mr. Sandford, and if possible, we hope that you would try to keep your remarks—your entire statements will appear in the record, so keep your remarks as brief as you can so we can have time for questions.

We'll just take you one, two, three and then go with questions.

STATEMENTS OF DONALD L. MILLER, VICE PRESIDENT, NAVIGATIONAL AIDS SYSTEMS, HAZELTINE CORP., ACCOMPANIED BY RICHARD F. FRAZITA, TECHNICAL DIRECTOR, HAZELTINE CORP.; LARRY J. BOWE, SPERRY CORP., FLIGHT SYSTEMS, ACCOMPANIED BY ERNIE ISLAVA, MANAGER, AIRLINE FLIGHT OPERATIONS SUPPORT, SPERRY CORP.; AND JOHN W. SANDFORD, PRESIDENT AND CHIEF EXECUTIVE OFFICER, THE DE HAVILAND AIRCRAFT OF CANADA, LTD., ACCOMPANIED BY R. KEITH WILLIAMSON, SUPERVISOR, SPECIAL PROJECTS, THE DE HAVILAND AIRCRAFT OF CANADA, LTD.

Mr. MILLER. All right. Is this—this is working?

Mr. GLICKMAN. Yes.

Mr. MILLER. Thank you, Mr. Chairman. Good morning to yourself and to the members of the committee and the guests. As you have indicated, I am Donald Miller, vice president of Hazeltine, responsible for the MLS program and associated NAVAIDS products.

I have with me this morning Mr. Richard Frazita, who is my technical director and has been very deeply involved in MLS and related technologies for many, many years. He holds several original patents in the MLS area.

As you—I have a prepared paper which will be submitted for the record, but I would like to draw from that a few——

Mr. GLICKMAN. Sure.

Mr. MILLER [continuing]. Key points.

First of all, we're very strongly supporting MLS and have been for many, many years. We took part in the early deliberations on the new technology which has since been identified as MLS, looked at the various technologies and, from the beginning, were a strong supporter of the microwave approach.

Initially, we sponsored the Doppler approach, which was in competition with the scanning beam. The scanning beam was selected; we immediately switched over to the scanning beam approach and supported that by supplying an initial equipment called the small community microwave landing system which was taken to Montreal in 1978 for the ICAO deliberations put in place, installed and turned on in a matter of 2 days, which is contrasted to the several months that the ILS system takes.

We'd like to think that that played an important role in bringing the ICAO world nations together in accepting MLS as the standard. That equipment was subsequently moved down to West Virginia where it's in operation today.

I think there are several key areas that we think are important with respect to MLS. First of all, we have the contract right now to

deliver 208 systems over the next 4 years and we believe that that's a good program. We're well along; we are, in fact, this week, conducting our preliminary design review with FAA at our facilities in Long Island. We'll be delivering the first equipments to the field in January of 1986 and then we'll be shipping five to six systems a month thereafter until the completion of the contract. We could increase that rate if necessary to meet user requirements.

We support the FAA's hub-and-spoke approach to implementation whereby systems are put in an area such as Boston or New York or Chicago, into the central airports and also the outlying airports, to enhance the ability of the smaller aircraft users, third-level carriers and such, to go into some of the airports with precision landing systems that are not able to support those today.

We also would like to see increased emphasis on other airports which are not part of the hub-and-spoke complex that could greatly benefit from MLS' capabilities.

We work with a variety of customers in our business: the Federal program and the non-Federal program and the international programs. In the non-Federal area, there are products which come under FAR 171, part J, which are not physically the same as those being procurred by the FAA, although the information presented—signal and space, if you will—is the same.

Today, those systems do not qualify for Federal support under the AIP program or the grant program and we would encourage your subcommittee and the FAA to continue to look at the possibility on including those systems under AIP to get systems into the field faster and get capability for the users faster. I think it will be very beneficial to States such as Michigan, which have been very aggressive in proceeding with their own program to advance the Federal program.

We think there should be increased attention to maximizing the early use of MLS' broad capabilities. It is clearly superior to ILS in many, many ways, and it offers the opportunity to accommodate a great variety of aircraft and helicopter types, to accommodate different kinds of terrain and the flexibility that comes with that will allow aircraft to come in from different directions and at different glide paths.

Mr. GLICKMAN. There is no question in your mind that MLS—will it, in fact, allow more aircraft to land and take off at airports than the ILS system will?

Mr. MILLER. Could I clarify that——

Mr. GLICKMAN. Yes.

Mr. MILLER [continuing]. Or expand on that? MLS offers the capability to accommodate more of different types of aircraft and to be more responsive to their different physical characteristics. The ultimate limit on the number of aircraft that can take off and land will be the concrete. What it does offer is if you should, say, have parallel runways or a helicopter pad off to the side, you could technically bring in more aircraft to these different landing locations in a better fashion than you could do today, but ultimately, that runway itself sets the limit on how many you can bring in——

Mr. GLICKMAN. But in either inclement weather or where you have unusual topography, an MLS system would allow you to bring

an airplane in perhaps more quickly and more directly than an ILS system.

Mr. MILLER. As a general statement, yes.

So we believe that there should be increased attention to exploring and adopting the more flexible capability that's presented my MLS. And as an internationalist, I think that there should be a strong recognition of the potential for MLS exports. There are many countries around the world that are already producing MLS designs, who will be going into production. We see the world market outside of the United States as probably 2,000 systems or so and that's a very, very attractive export market for the United States and we should continue with our emphasis on our own programs and, thereby, support U.S. manufacturers in the ability to export these products.

That basically summarizes my position. I'd be happy to answer any questions you have.

[The prepared statement of Mr. Miller follows:]

Presentation on Hazeltine's Microwave Landing System Program to the House of Representatives Subcommittee on Transportation, Aviation and Material Oversight

July 24, 1984

Good Morning — Mr. Chairman, Members of the Committee, and Guests,

I am Donald L. Miller, Vice President for Navigational Aids Systems at the Hazeltine Corporation and am responsible for all aspects of Hazeltine's Microwave Landing Systems program. I am appearing in response to your invitation to Mr. Sal J. Nuzzo, President of Hazeltine who was unable to attend due to a prior commitment. Mr. Nuzzo has asked that I express his regrets and at the same time convey to the committee his very strong and continuing commitment to MLS. If the occasion should arise, in the future, for additional discussions before your committee, he would be pleased to appear personally.

With me today is Mr. Richard F. Frazita, Technical Director for my organization and an acknowledged expert in MLS technology in the world aviation community. Mr. Frazita has 24 years of related experience. He has been active in MLS for some 16 years and holds several patents in the field. For your reference, I have attached to my material details of Mr. Frazita's educational and professional background, and a complete list of MLS related patents held by Hazeltine, including those of Mr. Frazita.

I would like to take this opportunity today to share with you our views on MLS and its importance as a key element in the U.S. National Airspace System (NAS) Plan and the world aviation community.

We have been strong supporters of MLS since the early systems definition efforts initiated in the late 1960s, actively contributing company resources and funds to its development over the past 14 years. Today there is no longer a question of "if" there is to be MLS, rather one of timing and priorities. Given the tremendous improvement that MLS will make in our National Airspace System, we believe that your continued commitment to and support of MLS is critical. During my presentation, I will address several key areas where I believe that emphasis should continue to be applied. These include:

1. Equipment delivery schedules that respond to the FAA's "Hub and Spoke" concept as well as other specific urgent needs.
2. Expansion of the Airport Improvement Program to include non-Federal installations of MLS ground equipment.
3. Increased attention to maximizing the early use of MLS' broad capabilities, thus providing more capability sooner to the user community.
4. Recognition of the export potential for U.S. manufactured MLS systems.

I will expand on each of these recommendations in subsequent sections.

BACKGROUND AND CURRENT STATUS

The selection of MLS as the precision landing system to replace ILS was not without much effort and dedication. The inherent limitations of ILS were recognized many years ago and the need for a replacement system was formally addressed in 1967. The conclusions reached during those early deliberations were tested and refined over several years, culminating in the establishment of an international standard in 1978.

Between 1970 and 1975, technique studies were undertaken under the sponsorship of the FAA and private industry to determine whether the "Doppler" or "Scanning Beam" MLS technique should be adopted. Hazeltine participated in those evaluations, supporting Doppler technology.

In 1975, the feasibility demonstrations were completed and the Time Reference Scanning Beam (TRSB) approach was selected by the U.S. At that time, Hazeltine initiated an aggressive company-funded program to develop a TRSB system. That in-house program resulted in the production of a Small Community Microwave Landing System (SCAMLS) for evaluation and demonstration to ICAO member countries at their 1978 working group meeting in Montreal. This system was installed in one day, and operational the next (as contrasted to the three to four months typical for an ILS installation). The results of the demonstration were positive and ICAO agreed at that meeting to adopt the TRSB approach as the international standard.

In 1982, we committed company funds to build 10 of our Model 2500 non-Federal systems based on a perceived user demand. That was the right decision. By September of this year, we will have MLSs in service in four countries — the U.S., Canada, Italy, and the U.K. Our facility in Cadillac, Michigan was the first unrestricted use MLS in the world, a tribute to the forward thinking of State officials. A second Michigan station is currently being checked out, and a third will be installed shortly.

An additional discussion of the history of landing systems is contained in the Attachment.

MLS vs ILS

Why MLS? Why not continue with further development and refinement of ILS? The reason is simply stated. ILS cannot and could not ever meet the wide range of user and operational requirements we face today and in the future. MLS has all of the essential features necessary to support the growth of aviation well into the next century. These include:

- Availability of 200 channels
- Continuous angle and range indication
- Improved signal quality
- Reduced sensitivity to siting and environment
- Wider guidance coverage sectors
- Basic system design and use of advanced technology.

All of these features are critical to expanding our National Airspace System and accommodating traffic growth.

On January 12th of this year (1984) Hazeltine was awarded a "Turnkey" contract by the U.S. Federal Aviation Administration for $90.6 Million dollars. "Turnkey" means that we are responsible for the development, production, test, installation, and check-out of 208 MLS ground stations. A total of 206 systems will actually be delivered for operational use. The balance of 2 systems will be used for training and support purposes. Our award is based on multi-year availability of funding, and was initially funded at $31.6M for the first two years of effort.

Under our contract; we will deliver operating systems to users beginning in January 1986, and for three years thereafter.

Each ground system consists of these two major elements:

1. The Elevation Station, which provides precise vertical (or Glide path) guidance over a range of 0.9° to 15° within the coverage volume, and,
2. The Azimuth Station, which provides directional guidance left and right of centerline within the coverage volume, and, a Precision Distance Measuring Equipment (DME/P) that provides very accurate distance information from the aircraft to the ground station.

Together, these equipments provide an aircraft with the guidance information required to make precision approaches to runways. Table 1 identifies the six production configurations and their characteristics.

Table 1. MLS production types

Type	Azimuth Antennas		Elevation Antennas	
	Beamwidth	Coverage	Beamwidth	Coverage
I	2°	±40°	1.5°	−0.9° + 15°
II	2	±40°	1	−0.9° + 15°
III	1	±40°	1.5	−0.9° + 15°
IV	1	±40°	1°	−0.9° + 15°
V	1	±10	1°	−0.9° + 15°
VI	1	±60°	1°	−0.9° + 15°

Figure 1 shows the signal coverage of a typical MLS Facility.

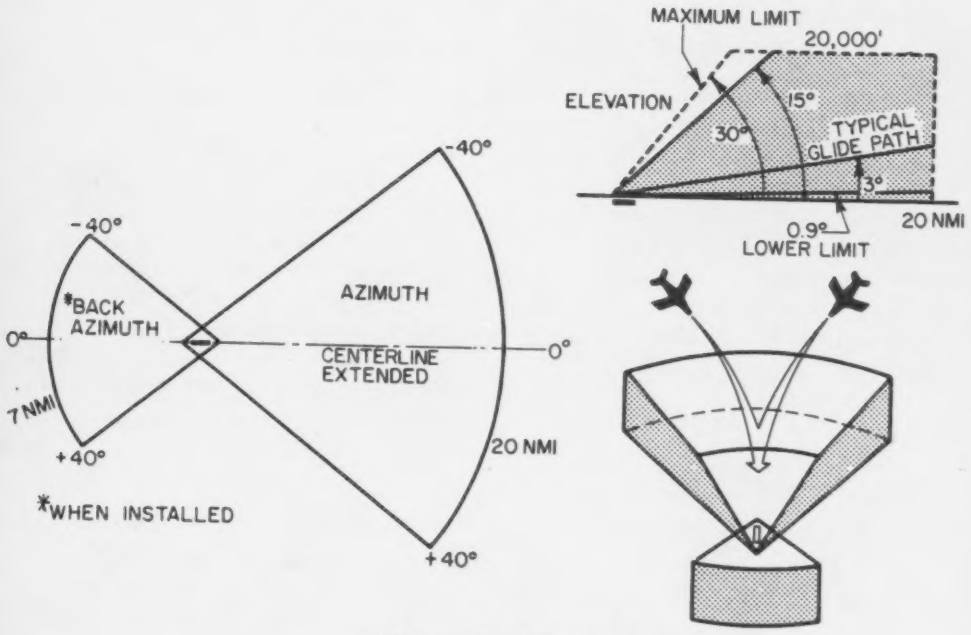

Figure I Signal Coverage

The FAA's MLS acquisition plan is structured to recognize the investment in ILS, the time required to introduce new avionics and procedures, and the need for a phased implementation plan during which both MLS and ILS will be available to users.

MLS and ILS will co-exist in the National Airspace System for many years before the phaseout of ILS is started. By international agreement, the FAA is committed to keeping existing ILS Systems in operation at international airports at least until 1995.

Initially, the FAA plans installations both at runways not now equipped with ILS, and also locations with ILS. They refer to this as the "Hub and Spoke" approach, whereby MLSs will be grouped to serve primary users in a given area. This does not preclude installations outside of "Hub and Spoke" areas, and there is considerable user interest in early implementation at many locations with difficult geography and those where heavy snow is encountered.

Because of the capabilities, the potential number of MLS installations will far exceed those of ILS.

For example, there are currently 800 or so ILS installations in the U.S. It is estimated that the system could accommodate no more than 925 before saturation. MLS installations under the current Federal program are projected at 1250 systems. In addition, there will be several hundred U.S. Military installations and another 1000 or so non-Federal systems. Even at those levels, there will be ample room for further growth.

ILS consists of three components — a localizer, that transmits a single course directional signal to create an electronic extension of the runway centerline, a glideslope signal projected on the same centerline providing vertical guidance nominally on a 3° slope to the runway, and a system of marker beacons. In each case, a single path of directional guidance is provided, so users must "line-up" and follow each other sequentially into the airport. Figure 2 shows the typical ILS signal coverage.

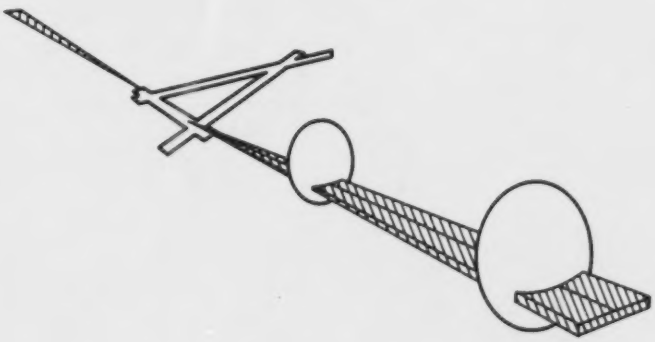

Figure 2. ILS Coverage

Over the past 40 years, ILS has come a long way and today's systems are a far cry from those early models. Improvements include advancements in antenna technology and the use of solid-state electronics. Unfortunately, there are some fundamental limitations that technology cannot overcome, and those will always be a constraint on the use of ILS. These limitations include:

1. Siting criteria. Because of ILS's sensitivity to geography and obstructions, its application is limited, and many airports that would otherwise qualify for a precision landing system are denied that capability. Typical of such locations are airports surrounded by hills, those close to metropolitan areas, and where snow accumulation occurs (northern tier states).

2. Size. Because of the operating frequencies of ILS (V/UHF), its antennas are large and require that land be leveled and extensively conditioned. This conditioning includes providing a large "ground plane" area in front of the Glide Slope antenna to form the beam in space.

3. Operational Flexibility. ILS provides a single course and glide slope. It is unable to accommodate the multiple approach paths and glide-slopes that are desirable for today's range of aircraft and terminal area flow control requirements.

4. Cost. The installed and operational costs of ILS are high and are not subject to significant reduction.

5. Frequency congestion. Only 40 channels are available.

With the introduction of commercial jet aircraft in the late 1950s and the increasing use of Short Takeoff or Landing (STOL) aircraft and helicopters, demands for precision landing systems at more and more airports grew rapidly. The inherent limitations of ILS have prevented many users from enjoying the benefits that a precision landing system would bring.

MLS TODAY AND THE FUTURE

In my opening comments I briefly mentioned the characteristics of MLS that respond to today's needs as well as establishing it as the world standard well into the next century.

What are the features of MLS that offer such benefits to so many users? In large measure, they are the ability to overcome the limitations of ILS as well as providing additional benefits that derive from the application of modern technology.

1. Siting Criteria. MLS is virtually insensitive to geography and obstructions. At most locations, the full ±40° scan coverage will be usable. At particularly difficult sites, the coverage can be reduced to ±10°. In addition, the scan coverage can be adjusted to extend further to one side and less to the other to accommodate special requirements. Because it operates at microwave frequencies, no extensive grading or land purchases are required as with ILS. The existing geography of any airport, large or small requires little or no modification for the installation and operation of MLS.

2. Size. Also due to its much higher frequency of operation (5 GHz) the antenna structure of MLS is small compared to ILS, and requires only a concrete pad for installation. It can easily be collocated with existing ILS facilities so that concurrent operations with both systems is possible.

3. Operational Flexibility. MLS provides multiple approach azimuth and glidepath guidance simultaneously available to a variety of users. For example, large commercial jets, smaller aircraft, STOL aircraft and helicopters can all conduct approaches designed for their specific capabilities. (See figure 3 for additional details of MLS equipment and capabilities.)

   An increasing number of aircraft are now being equipped with Area Navigation (R-NAV) capability. The MLS signal will provide for much broader and efficient use of R-NAV, using segmented and eventually, curved approaches. RTCA Special Committee SC-151 is addressing this operational requirement.

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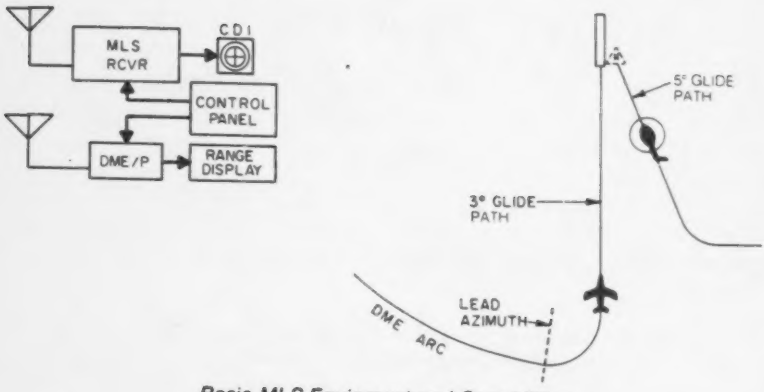
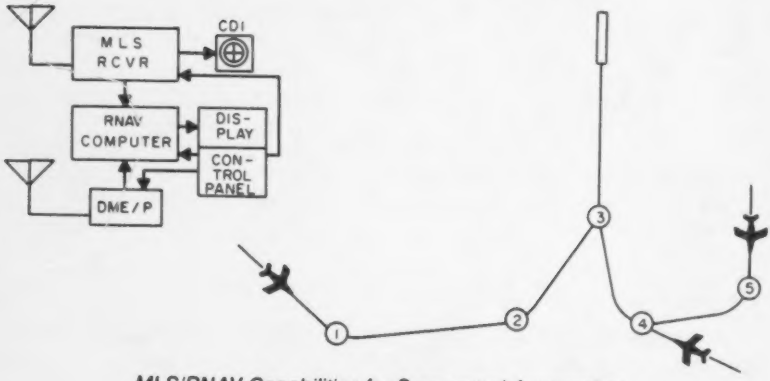
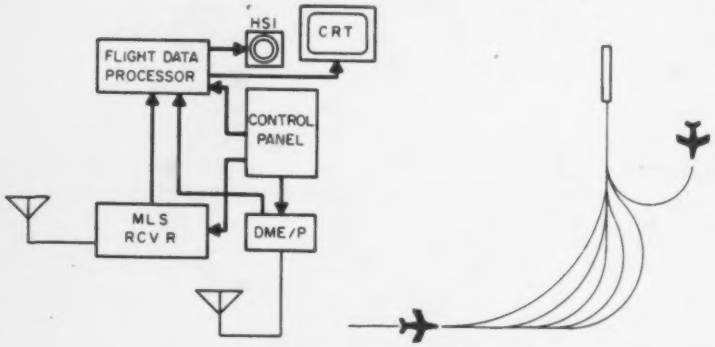


Basic MLS Equipment and Capabilities



MLS/RNAV Capabilities for Segmented Approaches



Curved Approach Capability

Figure 3

4. Cost. The installed cost of MLS will be less than that of ILS. In addition, the operational cost will be greatly reduced because of higher reliability and a feature known as the Remote Maintenance Monitor System (RMMS). Each MLS will be equipped to operate into the RMMS, providing a central FAA location in each region with full-time data on operational performance, and instant alert if any parameters degrade or fail. The maintenance technician will be able to identify exactly what has failed and carry only the necessary replacement parts to the location.

5. Frequency Congestion. Today, a significant limit on ILS installations is the availability of frequencies. All MLSs will be capable of operation on any one of 200 channels, five times that available with ILS. Thus, frequency congestion is not anticipated to ever be a constraint on MLS.

6. Landing Minimums. Since the MLS performance is insensitive to the environment and local siting conditions, the information transmitted is to the same highest standard (Category III). This will provide the lowest minimums possible consistent with other factors such as terminal procedures and aircraft/pilot capabilities. With ILS, however, the environment and local siting conditions can have a significant influence on the quality of the transmitted signal and this places significant constraints on the approach minimums.

7. Precision Distance Measurement. The DME/P will provide aircraft equipped with DME/P avionics final approach accuracy within 100 ft, compared to existing facilities providing 1200 ft accuracy. This is another key feature in achieving lower minimums. The DME/P will be completely interoperable with existing non-precision DME airborne equipments. The MLS/DME/P equipment group will also enable aircraft to use offset approaches where needed.

8. Automatic Monitoring. The MLS System has been specified by the FAA and designed to include several forms of executive monitoring. These include:

   a. Integral monitoring. Within the equipment, there is the capability to monitor the transmitted signal and perform verification testing of the monitor function itself without interrupting the emitted signal.

   b. Field monitoring. External to the equipment, there is a Far-Field monitor that receives the transmitted signal and routes it back to the main equipment for verification and comparison to the internally monitored functions.

   c. Maintenance monitoring. A constant analysis of equipment performance is conducted, with an evaluation of performance "trends" and failures. Upon detection, failures information or performance degradation information (even though it may not be outside of limits) is automatically transmitted to the aircraft controller and to the maintenance center.

   Such high integrity monitoring capability, required as we implement the lower flight minimums offered by MLS, has not been previously available in precision landing systems.

   Figure 4 shows a simplified block diagram of the Executive Monitoring Capability.

9. Equipment Flexibility and Growth Capability. The design of MLS provides for evolutionary growth that initially can provide airborne users with station identification and facility status. In its basic form, this information will be analyzed by the airborne receiver, and an alert provided to the pilot via instrument "Flags" should there be any problem on the ground. Expansion capability is available to transmit weather information over this channel, so that equipped aircraft will receive a continuous update on surface weather conditions during the approach.

The FAA's Automatic Weather Observation System (AWOS) program could provide the weather input to the MLS facility for transmission to aircraft. Further expansion capability is available and new requirements such as Back-Azimuth, 360° data coverage, etc., can be added as they are defined.

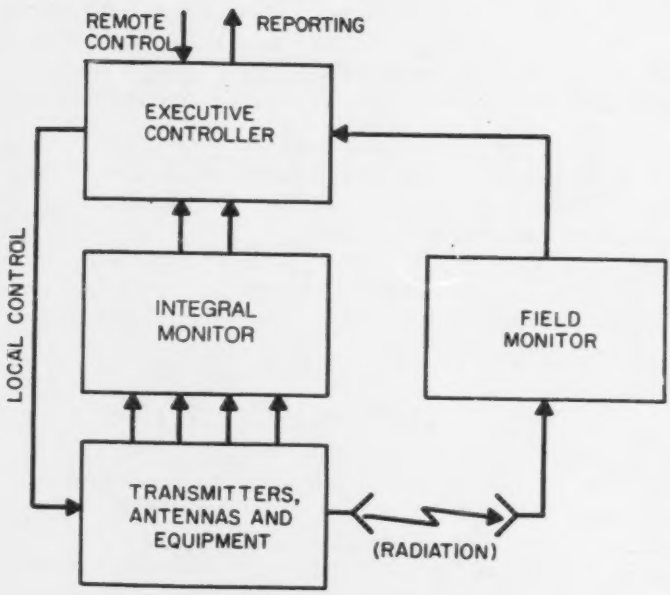


Figure 4. Executive Monitoring

MARKET ENVIRONMENT

Within the U.S., there are several major market segments for MLS. These include:

1. Federal Program. Civil Requirements identified as 1250 systems, to be provided by the FAA using Federal funds.
2. Non-Federal. A variety of programs including certain state and municipal requirements, and corporate and private users. Many of these programs do not presently qualify for Federal grants or support. In subsequent sections, I will specifically address state and municipal needs in relation to the Airport Improvement Program (AIP).
3. DOD. Fixed Base and tactical requirements, to be satisfied in part by add-ons to the FAA procurement program. A separate program to obtain tactical MLSs is being led by the Air Force.

MLS has also been adopted by NATO, and member countries are presently moving ahead with implementation programs.

4. Outside of the U.S., and in addition to NATO, there are several Ground Station development programs. In Canada, the second largest world market, the Canadian Government is supporting indigenous development of MLS, with plans to enter production procurement in 1985.

France, the U.K., Japan, Australia, and the USSR have similar funded developments. Our foreign friends and competitors see the world market for MLS as a very attractive export opportunity and are preparing to compete with us for these estimated 2000 systems.

Given our early lead here in the U.S., it is important that the MLS program continue to receive strong Congressional and Executive Branch support to ensure that American suppliers have equal opportunity to address this significant export potential.

THE AIRBORNE PICTURE

To utilize MLS, aircraft must be equipped with new avionics. In its basic form, the avionics required to fly any MLS installation whether civil or military, are the same. The military departments are presently assessing their needs and there has been some development effort initiated to meet their particular requirements. It is expected that a large percentage of military avionics installations will be accommodated with commercial off-the-shelf products.

At this time, there are two production suppliers of civil MLS avionics in the U.S. These are Sperry Flight Systems and Bendix Avionics both offering airline quality products. I also understand that several other avionics manufacturers are engaged in the development of receivers that will be needed to service the full range of civil aircraft requirements. In early recognition of the need for avionics to meet the FAA's Ground Station Program, Hazeltine undertook a company-sponsored development program, to produce an MLS receiver. That receiver was licensed to Sperry Flight Systems, which is currently producing it for worldwide commercial sales. In addition, Hazeltine produced 30 units for sales to its initial Ground Station customers.

The FAA's planned implementation schedule should motivate private industry to respond to user needs. This has traditionally been the case, and given the tremendous capability that MLS will provide, and the ease of installation, I would expect to see user demand develop rapidly.

It should be noted that the introduction of MLS into the cockpit has virtually no impact on the pilot, other than greatly improved navigation capability. The navigation information is displayed on the same instruments as are currently used for ILS.

OPERATIONAL CONSIDERATIONS

Unquestionably, MLS provides greatly improved operational capability and performance over ILS. At the same time, it presents a significant challenge. That challenge is in our ability to implement and utilize its enhanced features. It requires a lot of new thinking and creativity on the part of those who have responsibility for establishing airspace and approach procedures. Airspace designers, airport operators, controllers and the flying public must understand this new capability and begin its implementation at the start, rather than treating MLS as an ILS "look-alike."

We believe that your support in accomplishing this important task is merited. The earlier we start to utilize MLS's broad capabilities in operational service, the sooner they will become the norm. The value to the user community in utilizing approach procedures tailored to their specific needs and the ability to land with lower minimums will be clearly measurable in both time and dollars.

NON-FEDERAL SYSTEMS AND AIRWAY'S IMPROVEMENT PROGRAM (AIP)

There is an area that deserves further study and action, and it concerns the Administration's policy on Federal support for navigation facilities. The Federal MLS acquisition program does not address many state and municipal users due to current airport precision aid qualification criteria under the AIP Program.

Under the AIP Program, those airports that form part of the National Plan of Integrated Airport Systems (NPIAS) are candidates for support from either the FAA Facilities and Equipment (F&E) Program, or the Airway's Improvement Program, or both. Under those programs, the FAA may supply equipments and thereafter maintain and operate those systems, or, support user purchase of systems via AIP. In some cases, the FAA will then assume operations and maintenance responsibility for systems procured under AIP.

The difficulty arises when a user, such as the State of Michigan, elects to take the initiative and implement a system in advance of the availability of the FAA standard product. Federal Aviation Regulation 171 (FAR-171) Part J, defines the performance standards for non-FAA designed systems, such as those systems that are currently commercially available. Hazeltine's Model 2500 is an example.

These commercial systems provide the same signal-in-space, same immunity to siting, etc., as the FAA procured systems, however, they are not mechanically and electronically the same. In other words, the details of the design may vary, but the performance with respect to operational use is the same.

This creates a logistics problem for the FAA in taking over maintenance and operations. While there would be some cost and training impact, we feel that the benefits would far outweigh any investment required to support non-Federal systems. The more that can be done to motivate users, such as the State of Michigan, to proceed with their own programs, the better for everyone involved.

We understand that the FAA is presently re-evaluating their AIP criteria to determine if a change is appropriate. We heartily endorse this re-evaluation, and hope that it will result in more favorable consideration of non-Federal operators and users. At the same time, we want to urge that Congress actively support expansion of the AIP Program.

ALTERNATE VIEWS

There are voices in opposition to the timing and need for MLS. I won't attempt to respond to those opposed to MLS as I believe that they have had, and will continue to have ample opportunity to express their views. I think it useful to note, however, that there are two key aspects of human nature that must be appreciated:

1. The will to survive
2. Resistance to change

Sometimes the two are difficult to separate. Each time that new capabilities have been introduced into our National Airspace System, there has been opposition. Each time there has been improvement in operations and increased safety. We believe that this will be the same with MLS.

We can and should listen to the arguments of MLS opponents. What will not change, though, is the fact that ILS cannot provide for the needs of the 1980s and beyond. Needs such as lower cost, higher precision, operational flexibility, siting and installation ease and growth capability can only be addressed with MLS.

IN CONCLUSION

We are pleased to have been selected by the FAA to produce the first 208 MLS systems for use here in the states. Our program is moving along well and we are at this moment conducting our Preliminary Design Review with FAA officials at our Long Island facility. First operational installations will begin in January 1986, continuing at five to six systems per month through January 1989. If required, we could increase our production output to meet any foreseeable need. We have ample manufacturing and testing facilities to accomplish this.

Unquestionably, the world has come a long way since 1967. For the first time we have a common international standard for all users, Civil and Military, small and large, meeting the needs of the complete range of aircraft and helicopter types.

We believe that the worldwide commitment to MLS was correct.

- It is the right technical solution
- The timing is right, and if anything, overdue
- MLS is far more cost effective and operationally superior to the system it will replace
- We say this not just because we are the world's leading producer. Our record of company sponsored developments during the past 16 years is ample proof of our commitment and belief.

Thank you very much for this opportunity to express our views on MLS. We would be pleased to answer any questions you may have.

ATTACHMENT

LANDING SYSTEMS BACKGROUND AND DEVELOPMENT

Since the early days of flying, there has been a keen recognition by pilots that the real growth potential for aviation lay in the ability to reliably take off, navigate and land in virtually all weather conditions. The latter aspect, all weather landing, has been the most difficult to achieve on a consistent basis.

In earlier days of flying, aviators relied on four course low-frequency, radio range stations and nondirectional radio beacons for navigation and landing guidance. These were affected by atmospherics and interference and did not provide precision — a pilot's only known position was when he was exactly over the facility. Of course, in those days, aircraft were much smaller and slower than today's aircraft, so there was more margin for error. It was clear, however, that the growth in aircraft capability was moving ahead faster than that of ground navigational facilities.

In the mid-1940s, the introduction of Instrument Landing Systems (ILS) began, providing for the first time, a precision guidance capability. ILS systems operating at higher frequencies (VHF/UHF) than those early low-frequency facilities were more immune to external influences (atmospherics, interference, multipath) and were capable of being made "directional," an important criteria for a precision landing system.

Over the years, aviation experts around the world continued to examine alternatives to ILS.

By 1967, some 50 different systems had been proposed, with a significant number recommending the use of microwave frequencies. At the time, the 5 GHz band was not as well known as it is today, nor did we have the solid state and phased-array technology essential to attainment of high reliability and the precision navigation signals required of current systems.

In 1967, the Radio Technical Commission for Aeronautics (RTCA) formed a Special Committee (SC-117) whose function was to define operational and technical requirements for a single system that would satisfy all users world wide. At about the same time the International Civil Aviation Organization (ICAO) initiated similar studies, conducted in parallel with the SC-117 efforts.

In all, 23 different techniques were evaluated by SC-117. In 1970, their report defining the selected signal format was completed. Together, DOD, DOT, and NASA reviewed the SC-117 results and prepared a National MLS plan, to be implemented by a new FAA Program Office. Subsequently, RTCA established Special Committee 125 (SC-125) to address U.S. deployment of MLS, and SC-139, to develop specifications for the Airborne Receiver, companion to the Ground System.

Meanwhile, several commercial MLS installations (known as Interim Standard MLS — ISMLS) were made in the U.S. and Canada in the 1970s, serving airports that could not use ILS. While these were not TRSB facilities, these installations did provide precision instrument landing capability at locations previously denied this service. The Hazeltine TRSB SCAMLS System referred to earlier, was moved to Clarksburg, West Virginia in 1981 for operational evaluation and continues in service today

The DOD was an early and active supporter of MLS, and continues to be a strong supporter today. In fact, a major part of DOD's requirements (Fixed Bases) are expected to be filled via the FAA's program. The U.S. Navy and NASA's space shuttle program have made operational use of a similar system.

BIOGRAPHICAL OUTLINE
DONALD L. MILLER

Donald L. Miller is Vice President, Navigational Aids Systems, the Hazeltine Corporation, Long Island, New York. In this position, Mr. Miller is responsible for the management and operation of Hazeltine's Microwave Landing Systems (MLS) Program and related business activities. MLS is a new generation precision guidance system for aircraft approach and landing.

Mr. Miller joined Hazeltine in 1983 and came to the company after spending 22 years with Rockwell International/Collins Radio. His position with Rockwell, before leaving that organization, was Vice President, International, Commercial Electronics Operations.

Prior to that position, Mr. Miller held positions with Rockwell/Collins in Dallas, Texas, Hong Kong, Washington, DC and Cedar Rapids, Iowa. His primary responsibilities were in Marketing, Business Development, and General Management.

Mr. Miller attended the University of Maryland and Coe College and served 12 years in the U.S. Army as a Signal Corps Aviator, attaining the rank of Major.

Mr. Miller lives on Long Island, New York, with his wife and son.

RICHARD F. FRAZITA
TECHNICAL DIRECTOR
MICROWAVE LANDING SYSTEMS (MLS)

BIOGRAPHICAL NOTES

Date of Birth	August 1, 1938	
Education	BEE, 1960, Manhattan College, New York MSEE, 1976, Polytechnic Institute of Brooklyn, New York	
Patents, Awards	3,194,765	Simplified Doppler Antenna System (Low Cost Antenna)
	4,041,501	Limited Scan Array Antenna Systems with Sharp Cutoff of Element Pattern (Compact)
	4,117,494	Antenna Coupling Network with Element Pattern Shift (Wide Scan Compact)
	4,104,636	Doppler Reference Antenna with Phased Centerline Emphasis
	4,359,740	Microstrip Antenna
	4,188,633	Phased Array Antenna with Reduced Phase Quantization Errors (MLS Beam Steering)
	4,187,480	Microstrip Network having Phase Adjustment (Compact Adjustable Tilt Technique)
Publications	"Surface-Wave Behavior of a Phased Array Analyzed by the Grating Lobe Series", IEEE Trans. on Antennas and Propagation, Vol. AP-15, No. 6, November 6, 1967, pp. 823-824.	

"Phased Array Polarization-Prediction, Measurement and Design", presented at the IEEE Antenna and Propagation Symposium, AP-S Session 3, June 20, 1978.

Awards

1974 - Recipient of "Certification of Meritorious Achievement" from L.I. Chapter of AIAA for contributions to the advanced technological achievements made by Hazeltine in the MLS program.

1978 - Led the team that was presented the Special Award from the Air Traffic Control Association "For Outstanding Achievement and Contributions that Adanced the Science of Air Traffic Control and Enhanced the Professions of the ATC Systems."

1984 - IEEE Charles J. Hirsch Memorial Award "For contributions to the theory, development and implementation of the Microwave Landing Systems."

SUMMARY OF HAZELTINE'S MLS PATENT PROTECTION

U.S. Patent No.	Foreign Filings:
3,816,830	Canada
3,903,524	Australia, Canada, Czechoslovakia, E. Germany, France, Great Britain, Holland, Israel, Italy, Japan, Poland, Sweden, W. Germany
4,041,501	Australia, Brazil, Canada, France, W. Germany, Great Britain, Holland, Israel, Italy, Japan, Russia, Sweden
4,117,494	Australia (Parent and Div.), Canada (Parent and Div.), E. Germany (Parent), France (Parent and Div.), Holland, Italy, Israel, Japan, Russia, Sweden, W. Germany
4,143,379	Australia, Canada, France, Great Britain, Holland, Israel, Italy, Japan, Russia, Sweden, W. Germany
4,187,480	None
4,188,633	Australia, Canada, France, Great Britain, Holland, Israel, Italy, Japan, Sweden, W. Germany
4,191,960	Australia, Canada, France, Great Britain, Holland, Israel, Italy, Japan, Sweden, W. Germany
4,321,605	Australia, Brazil, Canada, France, W. Germany, Great Britain, Holland, Israel, Italy, Japan, Russia, Sweden
4,359,740	Australia, Brazil, Canada, France, Great Britain, Holland, Israel, Italy, Japan, Russia, Sweden, W. Germany

Mr. GLICKMAN. OK. Thank you very much.

Mr. Bowe, why don't you go ahead now.

Mr. BOWE. Mr. Chairman, thank you for this time that we can be here today and members of the committee. Our presentation—we have prepared six slides, and as you mentioned earlier, area navigation has been around quite some time, so we thought it would be beneficial to just very quickly set the basis for a discussion with a short background presentation. We will talk a little bit about the background of area navigation. Do you want to move, Wade, to the agenda slide, please.

[Slide.]

Mr. BOWE. And then we will—I'd like to then discuss some of the attributes of the system which contribute to both safety and some of the attributes that have to do with traffic congestion. We would then very briefly like to talk about some of the economic considerations of this type of equipment and then we will talk about an assessment of the benefits that have been gained thus far by area navigation and then would like to make some recommendations for what we believe will help to maximize those benefits in the future.

I have with me Mr. Ernie Islava, who is our manager of flight operations support in Phoenix, and I forgot to mention that my primary responsibilities for the last 5 years have been on the Boeing 757/767 FMCS where I've been the program manager on that.

Area navigation is a term which—covers quite a large realm of equipment. The types of equipment I have listed there are things such as INS, OMEGA/VLF. We have some low-cost systems which are VOR/DME-based, which are primarily used in our general aviation systems. We have the—the fully automated area navigation system, some of the more modern systems where the navigation data base is contained entirely in these systems and they are fully automated, and then the latest generation of systems which are in the commercial airlines and also being used in some of the upper end of the corporate aircraft, are what we call flight management systems, which are a combination of area navigation and performance fuel management system. So they control the entire flight regime of the airplane.

[Slide.]

Mr. BOWE. Some of the characteristics of the equipment which relate to safety—the primary characteristic of the equipment which is related to safety is the aircraft positioning capability of the system, and it is of utmost importance that the equipment tell the crew very, very accurately where the airplane is positioned and so, as we look at the benefits that can be gained in the future, we will expand a little later in the—in our discussions on what we believe some of the things that can be done to improve the accuracy because it is a key point.

[Slide.]

Mr. BOWE. The—the position of the aircraft is very, very important, and so is the flight plan that is put into the system. The flights plans can be put in, sometimes manually by just putting in simple coordinates in some of the simpler systems, or they can be put in automatically—in other words, the entire flight plan can reside inside the computer and is entered by the crew just by simply calling up a flight number. So the accuracy of that flight

plan, much like the position accuracy, is very, very important. Otherwise, we end up with a situation which, in the industry, we've—we say is, "You fly very accurately to the wrong place." So the flight plan is very, very important, just like the aircraft positioning.

One of the biggest advances that has been made in this type of equipment is in the area of CRT electronic map displays. The Boeing initially made a very bold step forward on the 57 and 67 and went to electronic instruments. They put an electronic map display in that airplane and—and that electronic map display is combined with the weather radar, and so now the flight crew has the ability to see their flight plan and it is overlaid by the weather radar and so they get a much better perspective of the situation of the aircraft.

These types of equipment—work load has always been a big concern, and it's something that we always pay very, very close attention to in the design of this type of equipment—is what is its—its impact on the work load of the crew?

The last area I wanted to mention is—is the area of software. This is an area where—these systems—in the early 1970's, the size of systems we were talking about maybe had 8,000 words of program. The systems we're talking about today have over 250,000 words of program, so they are very large software systems and this is an area that has gained a lot of attention within the industry, both privately and in the government agencies, about how do we make sure the software's safe.

Some of the impacts on safety—that these attributes can have on the ATC system—we believe that you can, in fact, get reduced lateral and vertical separation. As the equipment becomes more and more accurate, then it should be possible to reduce the separation standard and thereby get more capacity out of the air traffic contol system, yet not sacrifice any safety.

The same holds true of obstacle and terrain clearance. These standards are set based on the accuracy of the equipment on the airplane, so as the accuracy improves, we should be able to reduce those standards.

The nonprecision approaches—we have found that the introduction of area navigation equipment into airplanes now allows pilots to fly nonprecision approachs, such as VOR approaches, and they can get the vertical guidance from the area navigations system and thereby get a safer nonprecision approach.

Improved weather avoidance. Having the map display with the flight plan overlaying the weather is a tremendous aid to the crew in determining which way to guide the airplane to avoid the weather, so that was a big step forward in avoiding bad weather.

The fact that the crew now is much better informed as to what the situation of the airplane is currently and its future situation within the air space, the communications, then, between the crew and air traffic control are much improved because they have a better base on which to discuss the situation.

And we believe that area navigation, particularly in the future, if properly applied and once the number of aircraft that are equipped with it grows, that there is a—a real potential for reducing controller work load. Because we can fly an airplane very pre-

cisely over a predetermined path, both in the lateral position, vertical position and in speed, we can control that airplane very closely. The controller, then, knows we will fly that path and this should reduce his role to more of monitoring our progress and not having to tell us every—every direction to turn.

[Slide.]

Mr. BOWE. Some of the equipment capabilities which relate to the traffic congestion—as I just mentioned, the systems can very accurately track the flight plan that is put in or the path that the controller wants them to fly. The point-to-point navigation capability has been, of course, the number one feature of area navigation. Since very early have been able to fly direct from point to point. We also have the capability of flying parallel routes. You can actually tell the system that you want to fly left or right of a primary route by—by a certain number of nautical miles and this, in effect, increases the capacity.

The system does have the ability to make very accurate predictions of time and fuel and so this again helps the communications with the controller. We can better let air traffic control know what our intentions are going to be in the future.

The 4D capability—the—these systems—the modern systems have the capability of actually controlling the aircraft to arrive at a certain point at a certain time and we believe that the expansion of this 4D capability can have very positive effects on the 4D—or on the flow control of the FAA, because we can now tell an airplane to be at a certain place at a certain time and then we don't have to give as many vectors to him or as many commands to him to make sure that he does arrive at that time.

I believe that—we have listed there some of the other impacts that these features have on the air traffic control system and most of them are self-evident and if they're not, we have mentioned them.

I'd next like to talk a little bit about the economic considerations——

[Slide.]

Mr. BOWE. Because the RNAV system is somewhat unique. It can improve safety and when we speak of RNAV, we're really talking—it's a generic term, as I mentioned earlier, that covers quite a wide range of equipment, but it can improve safety and we believe that it can help to reduce traffic congestion and it can also, at the same time, help to reduce operating costs for the user.

I've listed there some numbers to give you an idea of the level of savings that are achievable with this type of equipment. The lateral navigation capability is—has the potential of reducing fuel usage by 1 to 3 percent. If you add the vertical axis and the performance management aspects of the system, you can get another 2 to 4 percent. Or in these flight managements systems where we combine both of these functions into a total full-flight regime system, we're looking at savings of 5 to 10 percent in operating costs.

So this is the big motivation for the airlines and the users for basically wanting the equipment is, yes, it can save them money, but it has also—it's been the No. 1—if we look at the economic situation, it's been the No. 1 reason why this equipment, particularly in the upper end of general aviation and in the airlines, has not

found the widespread use we had believed it was going to 10 years ago.

Mr. GLICKMAN. What was that again? What's the reason?

Mr. BOWE. I said the reason is the cost of retrofitting this equipment into older aircraft is very expensive and we believe that's probably been the No. 1 inhibition to the widespread application of this equipment in the current fleet of airplanes. But a major breakthrough was made when Boeing went with the flight management system as standard on the 757 and the 767. This said now a total new generation of aircraft were going to have standard on it area navigation. On every airplane, you have area navigation capability.

They were followed very closely by Airbus on the A310. They have area navigation standard on those airplanes. Boeing then followed with the 737300, which will have area navigation standard on the aircraft, and so will the new Airbus A320 aircraft.

So we can see a whole new generation of airplanes which are going to have area navigation capability as standard. And so we believe, in looking at the future, we want to look at what are those things that we can do to now to take advantage of that, to——

Mr. GLICKMAN. Does the DC9–80 have the equipment on there as standard?

Mr. BOWE. It does not have area navigation as standard, no.

[Slide.]

Mr. BOWE. The next slide just very quickly goes over some of the benefits that we believe have been gained to date. Direct routings are becoming very popular with those aircraft that are equipped, particularly in the new airplanes which can fly very high. You can get up there and you can typically not have any problems getting direct routing.

As I mentioned, the electronic map display and the precision guidance that we have provided in the systems have greatly improved the terminal area navigation capability of these airplanes. The pilots feel very much in the loop, in the terminal area now. They know exactly where they're at; they know exactly where all the weather is around them, where their flight plan is going and then when they receive vectors from air traffic control, they can see exactly what the impact of that vector is going to be on their flight path.

[Slide.]

Mr. BOWE. The next slide—we have put up a list of recommendations, and these are not intended at all to be an exhaustive list, but they are some of the things that we believe, as an industry, that we need to do in order to gain maximum benefit from this equipment. In the past, as manufacturers, our primary communications with the FAA have been with those people that certificate our equipment and we have a lot of communications, a lot of dialog with them, but we have had very few communications with the people that plan the system. So we believe that's an area where we really have to do a better job of communicating with the planners of the terminal area procedures, the planners of the enroute systems.

Our systems make a tremendous number of assumptions about the air traffic environment. We must make sure that as the air traffic environment changes that the assumptions we've made aren't violated and plus, as it changes, that it changes in a way

that enhances the use of our equipment and so we will then gain—we, the airlines, the users, will gain much more use out of this equipment.

In the area of air traffic control, we believe that we need to have better communications with the controllers. We need to better let them know what it is our equipment is capable of doing so then they can then use that knowledge and—in adjusting the way they control aircraft that are equipped with this—with area navigation. We believe the use of 4D time control needs to be promoted. We need to be promoting that and that as an aid in the flow control.

One of the keys to really improving the benefits from area navigation is to improve its position accuracy and two areas are critical to that: GPS and MLS. Those systems are well along in their development and we now, as area navigation and flight management industry, need to now start integrating those systems into our flight management and area navigation systems so as to provide better position accuracy which will in turn give us many of the benefits that we talked about earlier.

The number one concern—when we talked to potential users of this equipment, their number one concern is: Will we be able to use the equipment in the current air traffic environment, and particularly the area they always focus on is the descent. It's the area of flight where we have the least amount of control in the cockpit over the flight and so they're very, very concerned even though this equipment generates these very fuel-economic profiles for them. Will they be able to use it?

So we need to, as an industry, and with conjunction with the FAA, need to really do some research and do some work in the how to better integrate our equipment into that descent phase of flying.

We believe that there—we need to—and this will be the last thing I would like to really mention—is we believe that there needs to be a promotion of technical interchange between manufacturers and between the various users and government agencies. There are a lot of—there are a lot of splinter activities that go on, a lot of committees that meet, but we—we sense that there needs to be a very focused effort to bring all of these people together, maybe in some major symposiums and workshops, to get a better interchange of information as to what we are all doing in our respective areas.

Thank you.

[The prepared statement of Mr. Bowe follows:]

I. INTRODUCTION

This statement has been prepared by Sperry Corporation for the U.S. House of Representatives, Subcommittee on Transportation, Aviation and Materials to be presented by Mr. Larry Bowe at an oversite hearing on 24 July 1984. The statement is divided into six (6) sections which address the issue of Area Navigation impact on aircraft navigation safety and traffic congestion relief. The sections of the statement are as follows:

Section	Subject
II	BACKGROUND OVERVIEW OF AREA NAVIGATION
III	SAFETY CONSIDERATIONS
IV	TRAFFIC CONGESTION CONSIDERATIONS
V	ECONOMIC CONSIDERATIONS
VI	BENEFIT ASSESSMENT - CURRENT
VII	RECOMMENDATIONS FOR MAXIMIZING BENEFITS

II. BACKGROUND

II.A PRIMARY USERS

This statement covers Area Navigation (RNAV) and Flight Management Systems (FMS) as they apply to commercial transports and general aviation. Military use of this type of equipment is not addressed.

II.B EXTENT OF USAGE

General Aviation: There is a relative wide spread use of RNAV. The newer and more sophisticated systems are growing in popularity.

Commercial Airlines: The number of aircraft using RNAV/FMS equipment is small and generally limited to those aircraft equipped with INS; i.e., overwater equipped 747, DC-10, L1011 and the new Boeing aircraft, the 757 and 767.

II.C TYPES OF EQUIPMENT

INS - These systems have evolved into radio based RNAV systems but usage has generally been limited to enroute flying.

Omega/VLF - Originally conceived as an alternate to INS, these systems have also been used extensively by the General Aviation market.

Low Cost - Primarily used in smaller general aviation aircraft to allow point to point direct navigation. Basically an enroute system although some are used for RNAV approaches.

Fully Automated - This class of system was introduced in the 1970's and became feasible because of the advances in computer and memory technology. This class of system is flying on many corporate jets and on some airliners.

Flight Management - A Flight Management System provides full flight regime control by integrating the RNAV function with performance (fuel) management and full time guidance and control. These systems are the key to many of the benefits that can be achieved in the future. This class of system is operating primarily on the Boeing 757 and 767, Airbus Industry, A310 and in a limited sense on the Lockheed L1011.

III. SAFETY CONSIDERATIONS

III.A EQUIPMENT ATTRIBUTES

Aircraft Position Accuracy - The aircraft position as calculated by the RNAV system is the most important function relative to safety. Some RNAV/FMS systems are certified for use under instrument conditions; thus, the position must be accurate enough to insure aircraft separation and obstacle clearance. Improvements in position accuracy has been a key factor in the benefits derived to date and will be a vital area for improvement to achieve additional benefits in the future.

Flight Planning Accuracy - The flight plan which is entered into the RNAV system can be as simple as 1 or 2 fixes (waypoints) or a complete flight profile from takeoff to landing. This flight plan, however entered into the system (manually or automatically), must be accurate or we end up in a situation which is referred to in the industry as "flying very accurately to the wrong place".

Electronic Map/Weather Display - The introduction of the electronic color map display in the new Boeing and Airbus airplanes was a major step forward in safety. The flight management system sends data to the mcp which then displays the aircraft position and flight plan "right in front" of the crew. This flight plan can be superimposed on the weather radar data so the crew can see exactly where the weather lies relative to the flight plan. Other data such as navaids, intersections and near by airports can also be displayed.

Workload - RNAV systems can have very positive impacts on cockpit workload and therefore this is an area that always receives considerable attention when designing a new system.

Software - Nearly all RNAV/FMS hardware today consists of a digital computer and some input/output circuitry. The functions performed are almost entirely controlled by the software program that resides in the computer. These computer programs have grown from 8,000 words in the early 1970's to over 250,000 words in the newest generation of equipment. The industry has put considerable effort into defining the relationship between software design and aircraft safety.

III.B ATC SYSTEM IMPACT

The safety attributions of the RNAV/FMS equipment as presented above, can have very definite impacts on the ATC system. Some of these impacts are presented below.

Reduced Lateral and Vertical Separation - Separation standards are based on the accuracy of the positioning equipment within the airplane; thus, improvements in accuracy will allow reductions of lateral and vertical separations while maintaining a high level of safety.

Reduced Obstable/Terrain Clearance - This impact relates more directly to traffic density but the point should be made that, much like the impact on separation, improved positional accuracy can result in better utilization of the airspace without reducing safety.

Improved Safety on Non-Precision Approaches - RNAV equipment can provide precise vertical guidance on approaches which do not have a glideslope. The level of precision is a direct function of positional accuracy; thus, as accuracy is improved the safety of these types of approaches can be improved.

Improved Weather Avoidance - The electronic map display, which shows the flight plan and the weather patterns, allows the crew to make rapid decisions on how to avoid unsafe airspace. This data can be conveyed to ATC with an improved understanding between the aircrew and ATC as to the intentions of the aircrew. Additionally, the display of a wind vector on the map showing the direction of the wind and the magnitude is a valuable aid in dealing with windshear. Windshear is an area where the utilization of a ground to air data link such as ACARS has the potential of providing near real time information on surface winds; thus, aiding the crew in windshear prediction.

Better Communications Between Aircrew and ATC - The "upper end" of RNAV and Flight Management systems gives the crew a significant amount of information on the current status of the flight. This information has been shown to improve communications between ATC and the aircrew and thus reduce the number of conflicts between ATC's assessment of the flight status and the aircrew's assessment. As an example, if the crew is using a system which can automatically fly a STAR (Standard Terminal Arrival Route) and ATC knows this, then changes in altitude, speed, and heading which are performed automatically by the RNAV are expected by ATC, and any instructions they may give will be done with the knowledge that the airplane is being flown by RNAV.

Reduced Controller Workload - Aircraft which are equipped with the more sophisticated RNAV's and Flight Management systems can literally be flown automatically from takeoff to landing. If terminal and enroute procedures are structured to allow even a subset of this type of flying, then the controller, while still monitoring the flight of the aircraft, will not have to very often direct the aircraft; thus, his workload is reduced.

IV. TRAFFIC CONGESTION CONSIDERATIONS

IV.A EQUIPMENT CAPABILITIES

The following system capabilities are related to traffic density and congestion.

Accurate Route Tracking - Modern RNAV/FMS systems use a mixture of position sensors which allows them to fly the airways more accurately than with conventional VOR/DME. They can accurately fly terminal area procedures such as SID's, STAR's and approaches. These do not have to be RNAV procedures.

Point to Point Direct Routes - The ability to fly direct between two points is probably the Number One feature of RNAV/FMS systems. These direct routes can be anywhere from a few hundred miles to completely across the country.

Parallel Routes - Most RNAV systems have the capability to fly an offset to either side of an airway. Typically in one-mile increments up to 20 miles.

Precise Time, Distance, Altitude and Fuel Predictions - Flight management systems contain sophisticated mathematical models of both the airplane aerodynamics and the engine thrust. This allows them to make very accurate predictions of the state of the airplane at some future point in time.

Time of Arrival Control (4D) - Some of the more advanced systems have incorporated a time control feature where the system will provide the most economical flight while still meeting a specified time of arrival.

Holding Patterns - The more advanced systems provide the capability of automatically flying holding patterns at any point designed by ATC.

Precise Vertical Profile Control - The VNAV/Performance capability of the more advanced systems can guide the airplane through complex vertical profiles and controlling not only the altitude of the airplane but also the speed.

IV.B ATC SYSTEM IMPACT

The equipment capabilities described above can have very definite impacts on traffic congestion. Some of these impacts are described in the following paragraphs.

Reduced Controller Intervention - The fact that an RNAV/FMS has the ability to accurately fly all terminal area procedures in both the lateral and vertical axes means the controller does not have to provide nearly as much direction as would be required for a non-equipped aircraft. Once the controller knows the aircraft's RNAV capability, he is much more inclined to let the pilot perform his own navigation and thus provide more time for him to deal with other aircraft. As more aircraft become RNAV/FMS equipped, and as the accuracy and performance improve, more and more aircraft will be able to operate with reduced input from the controllers.

Increase of Available Routes - The use of parallel offsets and direct routings can, in effect, increase the number of routes rather substantially.

Improved Flow Control - The 4D (time NAV) capability that exists today in some RNAV/FMS systems can aid ATC in controlling the time of arrival of an aircraft into the terminal area. Aircraft with 4D capability can be used as lead aircraft with non-equipped aircraft spaced at fixed intervals behind them. This would allow several aircraft to arrive rather accurately at the specified times without a significant amount of controller intervention.

Improved Tactical Intervention and Controller to Aircrew Communications - The modern RNAV and Flight Management Systems provide the pilot with an exceptional perspective of the airplane's position within the airspace. When controller intervention becomes necessary, such as commanding a heading or commanding the airplane into a holding pattern, the pilot can see very clearly what impacts will result. This greatly helps the aircrew to comply with the controller's instructions.

V. ECONOMIC CONSIDERATIONS

A software unique situation with RNAV/FMS is that improvements in safety and congestion are achievable and at the same time user operating costs can be reduced.

Potential Cost Savings - A number of studies and revenue service analyses have shown that significant cost savings can be achieved through use of RNAV and Flight Management Systems. Typical numbers are shown below.

It is the level of savings, which makes the application of RNAV/FMS equipment very attractive to airlines and general aviation users.

- Lateral Navigation - 1% to 3% fuel savings
- Vertical/Performance Management - 2% to 4% fuel savings
- Full Regime Flight Management - 5% to 10% cost savings

V.A BENEFIT ASSESSMENT - CURRENT

1. The benefits have been small primarily because of the limited number of users. This is particularly true within the commercial airlines. Section VB presents some recommendations which the industry and government should consider in the interest of maximizing benefits from RNAV.

2. The Direct Routing capability is seeing regular use, particularly among the new aircraft which can fly above 39,000 feet where the traffic is not as heavy.

3. Aircrews on the new aircraft such as the Boeing 757/767 and the Airbus A310 are very enthusiastic over the enhanced operational capability given to them by the Flight Management System and the electronic map display. The crews feel that this is one of the best things done for the pilot in many years.

4. Performance Management Systems don't have any navigational capability, but they are being successfully used by a growing number of airlines. These systems are saving fuel and they give a good measure of what can be achieved by the performance function within a Flight Management System.

V.B RECOMMENDATIONS FOR MAXIMIZING BENEFITS

The following list is not an exhaustive list of recommendations, but it does contain a number of items which could have a significant impact on the benefits that are achievable from RNAV/FMS. Implementation of these recommendations will require a joint effort of the RNAV/FMS industry and applicable government agencies.

1. Increased Communications

Terminal Area Procedures - In general, do not take advantage of the capabilities of RNAV. RNAV/FMS designers need to work with the terminal area planners so they better understand the equipment capabilities and, in turn, they can design terminal area procedures which take advantage of these capabilities.

Enroute Navaid Planners - Modern RNAV and Flight Management Systems make numerous assumptions about the characteristics of the enroute ATC system and the navaids which support this system. It is extremely important that changes in the enroute navaid system be coordinated with the manufacturers so that key assumptions are not violated. The common types of changes such as frequency changes are handled very routinely through data base updates to the airborne equipment at regular intervals. Other changes which are more subtle, such as changing frequency protection limited, need a different form of communication.

Air Traffic Control - As an industry we have a significant amount of contact and communication with the FAA branches that are associated with certifying our equipment. We have very little contact with that part of the FAA that is concerned with integrating airplanes without equipment into the day to day air traffic environment. We need a method by which we can interchange information with the Air Traffic Controllers. It has been our experience that when the controllers are aware of our capabilities and we have consistentiy shown performance, then they are very anxious to jointly make use of those capabilities.

Responsibility - Increased communications could possibly be coordinated through organizations such as ARINC or RTCA.

2. Promote the Use of Time Control (4D)

The airlines and ATC need to work together to determine the extent that a 4D capability could be used in the near future. Airspace planners need to closely coordinate their efforts with the industry so the equipment capabilities will be supportive of their plans.

3. Aggressive Pursuit of GPS and MLS

This is an action that needs to be taken by the industry (equipment manufacturers and airframers). A significant amount of effort is going into GPS and MLS as stand alone systems, but not very much is being done to integrate them into RNAV and Flight Management Systems. GPS and MLS are key elements in improving the position accuracy so that many of the benefits previously discussed can be achieved.

4. Integration of VNAV/Performance into ATC

The number one concern expressed by potential users of the new Flight Management Systems is their ability to use the capabilities during descent. The descent phase is generally the time when the aircraft is most closely controlled by ATC. To achieve maximum benefit from the VNAV capabilities, the crew needs fairly unrestricted use of the vertical airspace until the airplane is within a few thousand feet from the ground. To solve this dilemma, practical research into the integration of VNAV into the ATC environment needs to be done soon so that use of this powerful capability can be assured.

5. The expanded use of ground to air data link has a lot of potential for reducing and improving communications between the air crew and ATC. While real time data link is part of the long term airspace planning, more near term use of the existing ACARS data link might be valuable in determining the ultimate benefits.

6. As a manufacturer of RNAV equipment we participate in many splinter activities with other manufacturers, users, and associated organizations, but we feel that there does not exist a good focal point for technical exchange on subjects that affect RNAV and Flight Management Systems. We believe that a major symposium dedicated to RNAV and Flight Management followed by regular workshops and conferences would have a major impact on expediting the realization of the many benefits that can be gained from Area Navigation.

Area Navigation/Flight Management Impact On Aircraft Navigation Safety And Traffic Congestion Relief

Prepared For

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Subcommittee On Transportation,
Aviation And Materials
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SPERRY

Area Navigation/Flight Management Impact On Aircraft Navigation Safety And Traffic Congestion Relief

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41

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AGENDA

- Background Overview of Area Navigation
- Safety Considerations
- Traffic Congestion Considerations
- Economic Considerations
- Benefit Assessment — Current
- Recommendations for Maximizing Benefits

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P5630-02-1

BACKGROUND OVERVIEW OF AREA NAVIGATION

- Primary Users:
  - General Aviation and Commercial Airlines
- Extent of Usage:
  - General Aviation: Moderate and Growing
  - Commercial Airlines: Minimal and Growing
- Types of RNAV Equipment — Application

Types of RNAV Equipment	Application
— Interial Navigation Systems (INS)	Enroute NAV
— OMEGA/VLF Navigation	Enroute NAV
— Low Cost VOR/DME Based (Low End Gen. AV.)	Enroute NAV
— Fully Automated RNAV With Integral NAV Data Base	Enroute, Terminal Approach
— Flight Management Systems (Full Regime Control)	Enroute, Terminal Approach

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P5630-02-2

SAFETY CONSIDERATION

- Equipment
  - Aircraft Position Accuracy (Lateral and Vertical)
  - Flight Planning Accuracy
  - Electronic Map/Weather Display
  - Workload Impact
  - Software
- ATC System Impact
  - Reduced Lateral and Vertical Separation
  - Reduced Obstacle/Terrain Clearance
  - Improved Safety on Non-Precision Approaches
  - Improved Weather Avoidance
  - Less Conflicting Data Between Aircrew and ATC
  - Reduced Controller Workload

TRAFFIC CONGESTION CONSIDERATIONS

- Equipment Capabilities
  - Accurate Route Tracking
  - Point to Point Direct Routes
  - Parallel Routes
  - Precise Time, Distance, Altitude and Fuel Predictions
  - Time of Arrival Control (4D)
  - Holding Patterns
  - Precise Vertical Profile Control
- ATC System Impact
  - Reduced Controller Intervention Laterally and Vertically
  - Increase of Available Routes
  - Improved Flow Control
  - Improved Tactical Intervention
  - Improved Controller to Aircrew Communications

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P5630-02-4

ECONOMIC CONSIDERATIONS

RNAV Can Improve Safety, Reduce Traffic Congestion and at the Same Time Reduce Operating Costs

- Potential Cost Savings
  - — Lateral Navigation — 1% to 3% Fuel Savings
  - — Vertical/Performance Management — 2% to 4% Fuel Savings
  - — Full Regime Flight Management — 5% to 10% Cost Savings

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BENEFIT ASSESSMENT — CURRENT

- Overall, the Benefits Achieved to Date Are Small Compared to What Is Potentially Achievable
- Direct Routings Are Becoming Common for RNAV Equipped Aircraft
- Precise Position, Guidance and Electronic Map Have Significantly Improved Terminal Area Navigation and Controller Communications
- Electronic Map Has Enhanced Enroute and Terminal Area Safety
- Enroute Use of Performance Management Is Saving Fuel
- Aircraft With the Newest Generation of Flight Management and Map Displays Are Able to Rapidly Evaluate the Impacts of Alternate Flight Plans or Strategies

SPERRY

P5630-02 6

RECOMMENDATIONS FOR MAXIMIZING BENEFITS

- Increased Communications Between Equipment Manufacturers and FAA
  - — Terminal Area Procedure Planning
  - — Enroute Navaid Planners
  - — Air Traffic Control
- Promote the Use of Time Control (4D) Capabilities
- Aggressive Pursuit of the Integration of GPS and MLS into RNAV/Flight Management Systems
- Promote Practical Research on the Integration of VNAV/Performance into the ATC Environment
- Promote Technical Interchange Between Equipment Manufacturers, Users and Applicable Government Agencies (NASA). (Symposiums, Work Shops, Conferences)
- Promote the Development of Expanded Use of Ground-to-Air Data Link (ACARS) to Improve ATC to Air Crew Communications

SPERRY

P5630-02-7

Mr. GLICKMAN. Thank you.

Mr. Sandford, it's a pleasure to have you here. I enjoy flying your airplane. I wish that some of our American manufacturers had done as well as you have in the commuter market.

Mr. SANDFORD. Thank you very much, Mr. Chairman, members of the committee.

Mr. Chairman, you expanded upon the problem that we see in the airports today very well. It doesn't need me to go into it any further. I think we're all very conscious of that.

We at de Haviland Aircraft have also seen this problem and worked at it from an aircraft and from an integrator's viewpoint, bringing together the systems that are necessary to provide an aircraft which can in some way, in addition to solving the major transportation problem it's trying to handle, get the aircraft into airfields on a timely basis.

At de Haviland, we have spent the last decade in working on this quite actively and I will take you through a brief amount of that history. I have with me today the gentleman in our company, Mr. Keith Williamson, who is primarily responsible for the application work that goes on. I shall be talking about systems and components that have been developed by many companies as well as agencies and programs that have been funded out of the private sector, as well as through some Government funding.

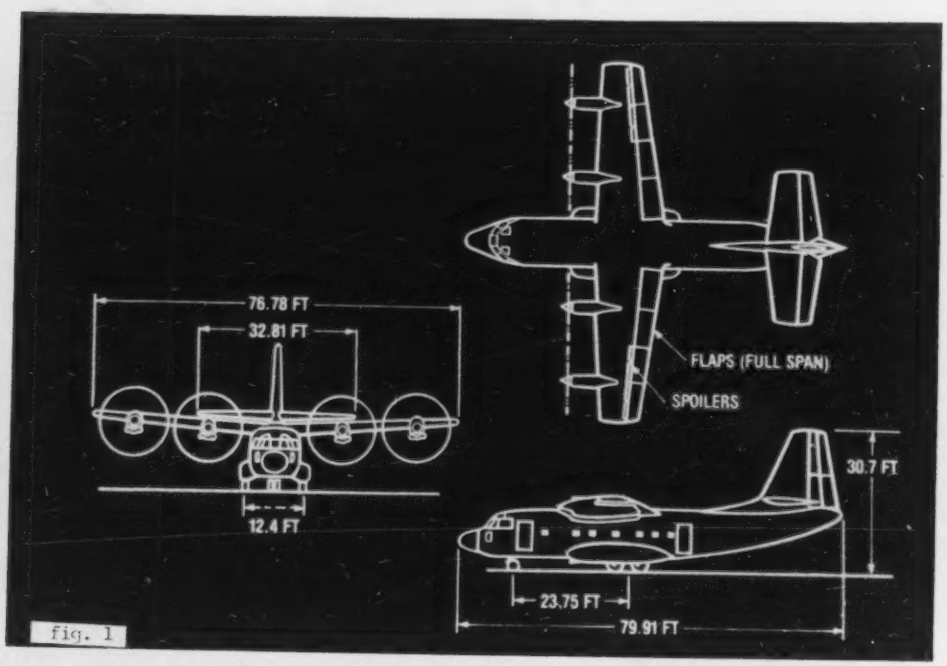


fig. 1

I might say that there have been a lot of people who have seen the problem and have spent a great deal of effort and money in coming up with solutions. I shall just drift by most of that, but I would say the first work was—the first time the problem was attacked in any vigorous way where the total requirement of aircraft on-board systems, grant systems and at the airport, where they were all tackled first was probably on the project with Eastern Airlines in Breguet—with Breguet aircraft and later became known as

the McDonnell Douglas—or Douglas, I guess it was then, the 188 program—and that was really the late 1960's, early 1970's time period. That program had a great deal of imagination behind it, but it was probably, as they say, ahead of its time.

Next slide, Keith.

fig.2

Mr. SANDFORD. This just shows an illustration of what was considered to be an advanced STOL aircraft which could use the same techniques that we're talking about today.

Next slide.

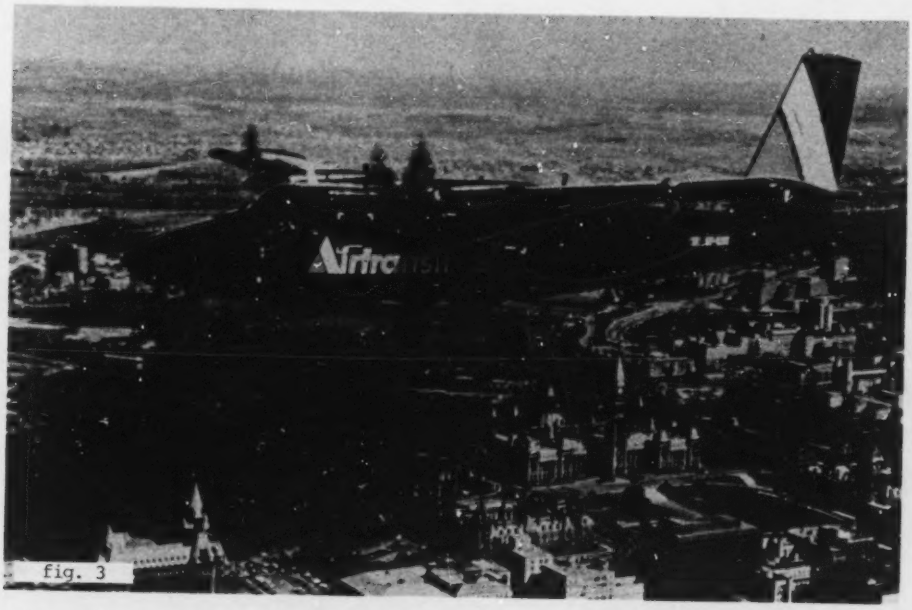


fig. 3

Mr. SANDFORD. We got into the act as an organization in 1974 where we said exactly the same as has been said by the early re-

searchers, that the system is there. The aircraft—we built STOL aircraft; that was an important ingredient. The area navigation system was available. What we needed to do was to develop the procedures that would allow this to be used.

We saw the congestion problem; we saw a solution—which didn't really happen—which was the downtown-to-downtown airports. This was a particular program using Twin Otter aircraft at that time started in 1974, flying between Ottawa and Montreal. It was a subsidized program, to work out the systems and the procedures. It worked.

Next slide.

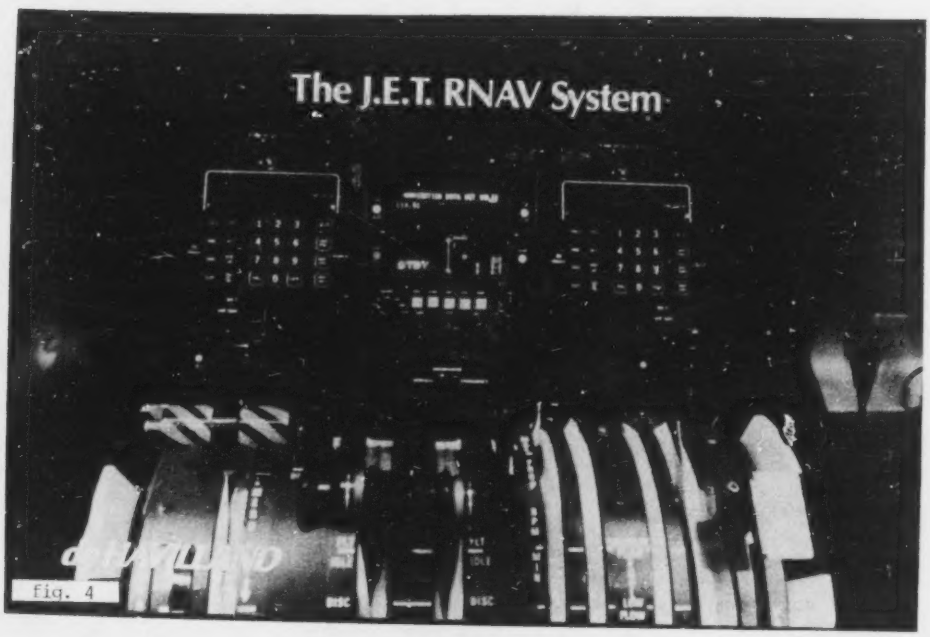


fig. 4

Mr. SANDFORD. In 1977, Dawson Ransome, who will be appearing here, or speaking to the committee a little later on, saw exactly the same problem, but he saw that aircraft were developing and the avionics were coming along at a more advanced fashion. But the problem was there at that time. The airport congestion, slot potentials coming in and restrictions into airports. And, of course, he could see expenses going because the solution is to hold the aircraft off, as you pointed out, Mr. Chairman.

What was seen by Ransome was that a new breed of aircraft were coming along, and I shall naturally refer to the de Haviland aircraft, although we're by no means exclusive in this field. We like to feel we have an edge, but I'm sure our competition would say there is no edge there at all, but what Ransome and other operators saw was that you could begin to combine now the features of an aircraft such as the Dash 7 with its short takeoff and landing capability, its relatively steep approach—a steep approach relative to the way jets come into play, and also, of course, the advanced avionics.

These were coming along very nicely. The advent of microprocessors, the electronics that we're all very familiar with—our children are more familiar than us—but this shows a typical installation of

an RNAV system in a de Haviland Dash 7. This happens to be one of the Ransome Dash 7's.

I should point out that probably one-third of the aircraft that we deliver today in this size category use area navigation systems and with the more advanced avionics that are coming along in the class display, we'll see more of the feature that talked of by Sperry, Inc.

In addition to this, of course, the microwave system had been adopted in the 1970—in the late 1970's time period as an international standard and the ability to blend this with the RNavigation system to give you more flexibility at the terminal and precision coupling between your en route and your terminal control was an obvious thing which was there with us in 1977.

Along with that, of course, the Hazeltine, Bendix, and others were developing the ground systems that are necessary.

Next slide.

fig. 5

Mr. SANDFORD. This shows the fundamental elements of a microwave landing system which is relatively inexpensive and inexpensive to install and simple to install, as has already been pointed out. These things were all coming together individually and what Ransome and others saw was the ability to integrate them.

This led to what we refer to as the separate access landing system and with a particular application initially in Washington, DC. As we all know, Washington National is probably the most complicated airfield to get into, one of the most congested fields because of the restriction, overland restriction you've got and an awful lot of people wanting to come in here; aircraft with different landing characteristics, different approach characteristics, a very complex human, mechanical, and electronic interfacing job that needs to be done.

We undertook with Ransome—and I should say that Dawson will endorse it—that both companies saw this, decided to invest what, to us, was more than a modest amount of money into putting this

system into application. We needed, of course, total cooperation from the FFA and from the controllers and from the flight crews of the other aircraft because what we were talking of doing—next slide, please.

[Next slide.]

Mr. SANDFORD. Oh, that was to say, the air traffic controllers. The next slide again.

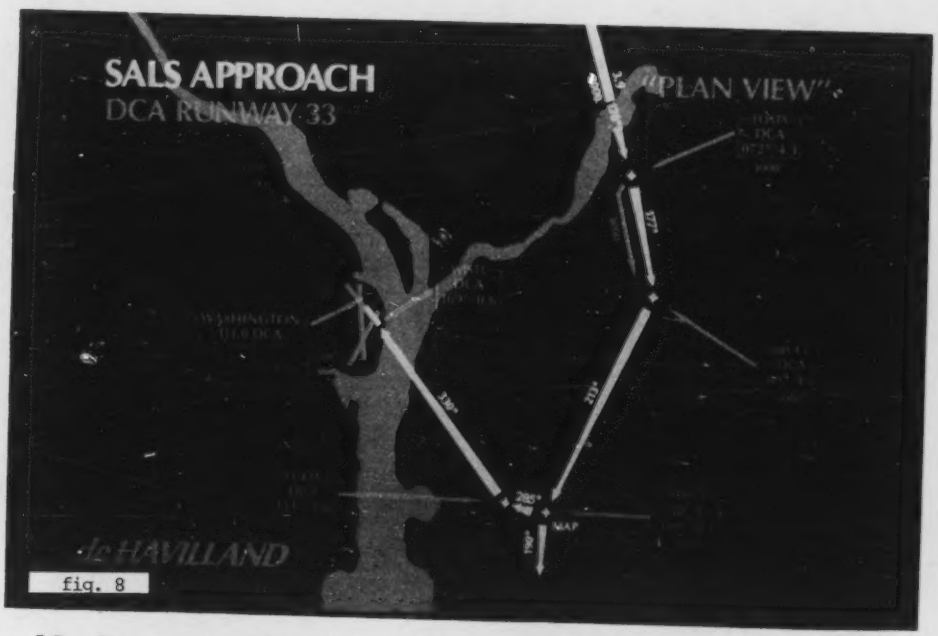
[Next slide.]

Mr. SANDFORD. What we were—what we're talking of doing at Washington National is, of course, what is routinely performed

there today, but which 5 years ago was extremely innovative and that was to come in on a intersecting runway and to do this with total safety. This required the development of new procedures, new approach procedures, but what made it feasible was the elements that I've talked about already: namely, the area navigation system which could control you coming into the airport; also the ability to come in with a steep approach, and the fact that short take-off and landing aircraft under missed-approach conditions, for example, with all of the adverse conditions you must assume, can come in, land on that runway or go around on a missed approach without intersecting the plane of the runway, something which we would not have been able to do a number of years ago. But these features have been built into aircraft.

OK, next slide.

[Slide.]



Mr. SANDFORD. This shows the approach that is followed to come in on Runway 33. Without boring you with the details of the specifics, it follows a normal flight path in except that the main traffic is flying above it and going further on to pick up with Runway 36, which is the one which is, of course—goes north and south on that page.

And you can see there illustrated the less than 2,400-foot runway which is now routinely used at Washington National and provides additional capacity to the airport. It gets these aircraft out of the mainstream, provides additional slots at the airport, and that is the capacity—that is attacking the capacity problem that you're referring to, Mr. Chairman, which has aircraft lined up all over the place while other ones are coming in and coming out.

Mr. GLICKMAN. Let me wait a second. You've got a plane, a Dash 7, coming in on that runway, what you call 33, that is—

Mr. SANDFORD. Yes.

Mr. GLICKMAN [continuing]. To the north—northeast there—northwest, and a plane will be landing there, or could be landing there simultaneously with a—[audio feedback]—simultaneous, OK.

Now, your plane—what's the distance between the end of Runway 33 and the crossing point?

Mr. SANDFORD. 2,300—2,380 feet.

Mr. GLICKMAN. OK, now what's the normal landing distance of the Dash 7?

Mr. SANDFORD. Well——

Mr. GLICKMAN. That's a variable——

Mr. SANDFORD. Can I put it differently to you, Mr. Chairman? Following all of the regulations that we require which consider things such as "I'm coming down, I can't get in, there's an obstruction on the runway, truck on the runway. I've now got to go and make a missed approach." That's one thing you've got to consider.

Another is that you have to, of course, halt with, under adverse conditions, water on the runway, heavy weights, adverse things. Following all of those conditions, you could put a brick wall at 2,200 feet and the insurance company would never pick up a penny. You would never hit the brick wall.

I think that is a way of describing it. As I say, also, the aircraft, when the pilot decides that he must execute a missed approach, again, with the adverse conditions we must assume which caused that adverse approach and onboard systems not working as they should, he has to be able to turn around and not intersect that plane of the other runway.

I should note that, to my knowledge at least, in the 5 years that this has been operated, and it is principally Henson and Ransome that uses this into Washington National, and in the time that's been used, to my knowledge, there has not been an incident at Washington National that has. If I might must refer to Dawson for a moment—Dawson is here?

Mr. RANSOME. None at all.

Mr. SANDFORD. No incident at all.

Mr. GLICKMAN. Now, the key capability that allows you to do this is the STOL characteristic of the airplane, or is that——

Mr. SANDFORD. Mr. Chairman, that's one thing. That is a very important ingredient, but equally important in the general application is having the instrumentation onboard and on the ground to guide you in. So it's an integrated system you need. You must have the airplane with its characteristics and, yes, it must be STOL to do it on that short a strip, but that's a—that's a relatively unique situation, the 2,300 feet. I mean, we can find other applications around the country where there are 4,000 feet and we've even found some where there's more than that.

Mr. GLICKMAN. Yeah.

Mr. SANDFORD. Because they're not all as complicated and terrain-governed as this particular airfield is.

Mr. GLICKMAN. Is it used at other airports, this system?

Mr. SANDFORD. Yes. Mr. Ransome, I think, will address in applications, but it's—we are working in Europe at Heathrow, working in the Docklands STOL port in London. We're working in Vancouver in Canada, Valdez is good in Alaska. It doesn't do anything in

saving runway, but it uses exactly the same techniques and I'll be addressing that a little later on.

Mr. GLICKMAN. OK.

Mr. SANDFORD. But this—I mean, this is—let me not suggest this as a panacea whereas theoretically it can give you twice the capacity at your airports. I think we're a long way from seeing you doubling the capacity of the airports, of being able to do this, but you can get incremental capacity as we're getting at Washington National today.

Kennedy is another airfield where this is routinely available. We are now working with the airlines and the FAA at O'Hare, which is a very difficult and congested airport, but where we believe there are suitable solutions for improving the capacity.

I've listed there just what we see are airports that will face saturation in this decade and you can see it's a fair list and that's without real knowledge of how the air—how the air traffic will change under deregulation as airlines move their hubs around. But in our opinion, you're faced in the United States with saturation at most of the major airports that any one of us would recognize. That saturation is going to occur in the decade. In our opinion, the technology of aircraft avionics systems and the air traffic control can relieve that congestion. It will not totally alleviate the problem; it will help it.

I have concentrated so far in this brief discussion on the hub. Let me now go to the spoke because what we're discussing, too, is providing transportation into—regular transportation, routine transportation, safe transportation into areas which are difficult because of terrain, because of weather, and in our opinion, the systems which solve the problem—can help solve the problem at the hub can also be of major benefit at the spoke, at the other end.

Next slide, please.

This happens to be at Aspen, which has a particularly tough approach. It is a high-altitude airfield. It has quite a bit of runway there, but what you're looking for is schedule maintenance and you do that by having better avionics. Because I like aircraft and mountains, I decided to throw that one in just to show that it is difficult terrain, but this provides safety. The MLS, of course, system has, by inherently better ability to glide to provide curved approaches, if you will, segmented curved approaches, which can take you around mountains under full control——

Mr. GLICKMAN. As a frequent skier in the Aspen area, I appreciate that. [Laughter.]

Mr. SANDFORD. Very good.

Valdez is probably one of the toughest airfields that we have seen. Again, not the ability to get in and out on good days, but the ability to do it when the weather is leading you to minimal conditions. This shows the sort of conditions that a pilot looks at out of his window at the time he's deciding to execute a missed approach. Now, if you are under complete control at that time and if you are following an MLS path, which you can do, and you have an aircraft which has a steep-approach capability such as the aircraft that we and others are building, then you can get around to these approaches under them quite safely.

So, if I might summarize, we find ourselves today, due to the investment of many companies and particularly the vision of many people in the 1970s with what we believe is a operational system today. It is just limited operation at this point in time, limited application.

The avionics is here; it's present; it's with us today and, of course, the aircraft are flying routinely. These are not experimental aircraft; these are regular aircraft.

What are the benefits? Some of the earlier speakers have mentioned them, but as we see it, from an air traffic control viewpoint, we can alleviate some of the congestion. It has certainly been done here at Washington National; could be done more generally and could be increased here.

It also has the ability, as has already been mentioned, to reduce the work load on the air traffic controllers. It also is a very manageable work load onboard the aircraft. There are fuel savings. Those have been mentioned and I'm sure Mr. Ransome will mention to you the kind of fuel savings that he picks up. We quote about 40,000 gallons a year of fuel that he saves per aircraft by using the RNAV system between here and Philly.

It, of course, can obviously reduce delays, which is one of the things the chairman is talking about, because you can get out of that daisy chain coming into the airport and you can be totally separated, and particularly in a commuter whose total leg may be only 40 minutes, to spend another 40 on the ground is both frustrating and expensive to him, very tiresome to the passengers.

Next slide.

Well, I think we've covered the airport things already in terms of benefits.

The future—I'm not coming to you, which is probably unusual, saying you've got to spend lots of money. I think as we see the future, the congestion problem is there, but, you know, if you can put in a 3,000-foot runway or extend a taxiway and extend the—delay the saturation of an airport for 5 years, I think we've done a great job and it'll pay for every bit of research that's been put into this program so far.

There are—there is congestion and saturation being faced very quickly. The system, as I say, is proven. There are both benefits at the spoke and at the hub. And really what we need to do now is—and I think I cover it better in the next slide—could you just, which is my last slide as I recall—no, it isn't. Back up one if you can.

Next slides.

SUMMARY

1. STOL/RNAV/MLS TECHNOLOGY IS PROVEN

2. OPERATIONAL PROCEDURES ARE PROVEN AND BENEFICIAL

AIRPORT ACCESSIBILITY PROBLEMS CAN BE SOLVED, IF WE TAKE THESE THREE STEPS:

1. NEW STOL/MLS/RNAV CRITERIA MUST BE DEVELOPED

2. CONGESTED HUB AIRPORTS: DETERMINE FEASIBILITY FOR UTILIZATION OF RELIEVER RUNWAYS, STUB RUNWAYS, AND/OR TAXIWAYS

3. REMOTE AND/OR HIGH TERRAIN AIRPORTS: PROCEED WITH DEVELOPMENT AND IMPLEMENTATION OF MLS

FUTURE

- AIRPORT CONGESTION WILL CONTINUE TO INCREASE
  - LA GUARDIA, O'HARE ALREADY APPROACHING SATURATION POINT;
  - MORE TO COME
- SALS HAS BEEN OPERATIONALLY AND PROCEDURALLY PROVEN AND CAN BENEFIT ANY HUB AIRPORT
- LET DCA SET THE PRECEDENT FOR DEVELOPING FAA CRITERIA FOR SALS PROCEDURES AT OTHER HUBS

What I wanted to mention was that right now the approach that we're using is that we, the airline and the local airport, get together and work out what we think is going to happen. What we would ask be done, and what we suggest we're ready to do now, using Washington National as a standard, is to begin to produce the criteria and the standards so that we have a common approach to this.

Simultaneously, we should be looking at the airfields. We are doing this as a company and doing it with the operators, but I think it would be beneficial to examine more rigorously and on a more comprehensive basis the airports at which the application of the technologies I have talked about can delay the airport saturation and give you greater capacity.

As I say, we have spent time looking at O'Hare, La Guardia, Kennedy, Washington National, Atlanta, San Francisco, in addition to the remote areas, and in all of those places, we are able to find a solution that matches the criteria which we are applying at Washington National. Those need to be standardized. A set of regulations set down so that future designers can make sure they design their aircraft to those criteria, and that we don't do them on an ad hoc basis.

That is what I need to do. This is a software job, but I think it's one that needs to be done. I think without bothering to go over it—I've taken up quite a bit of time, Mr. Chairman, I'll just summarize by saying the system is here; it's using—many people fly on it today. We need to get broader application and through that, maybe be able to increase the capacity of our airports by 15 percent or more rather inexpensively.

Thank you very much.

[The prepared statement of Mr. Sandford follows:]

U.S. HOUSE OF REPRESENTATIVES

SUBCOMMITTEE ON TRANSPORTATION, AVIATION, AND MATERIALS

TO THE

COMMITTEE ON SCIENCE AND TECHNOLOGY

AIRCRAFT NAVIGATION AND LANDING TECHNOLOGY

***

AREA NAVIGATION, STOL TECHNIQUES, AND MLS

POTENTIAL FOR DEVELOPMENT

***

Presented by

John W. Sandford
President and Chief Executive Officer

The de Havilland Aircraft of Canada, Limited

Tuesday, July 24, 1984

38-615 O - 84 - 5

U.S. HOUSE OF REPRESENTATIVES

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INTRODUCTION

My name is John Sandford. I am the President and Chief Executive Officer of de Havilland Aircraft of Canada. We are a company that has for many years specialized in the design, development, and production of small transport aircraft, many of which are in service with U.S. airlines and government agencies.

It is an honour to be asked to appear before this committee to talk on this subject. The technology related to air traffic control navigation, airport access, and aircraft design that has been developed over the last 15 years or so is now operational and is needed to help in solving today's problems related to increased air traffic in the United States, Canada, and many other countries.

We at de Havilland have been very concerned about the growing problems that some regional airlines face in providing safe service to the travelling public wishing access to crowded, major city hubs as well as remote destinations. Like many others, we foresaw the congestion and difficulty of access problems and have utilized the technology to find low-cost, safe solutions. We have tailored the design of aircraft and have incorporated modern navigation and systems and have worked with the air traffic control authorities and the airlines to achieve this.

I am most pleased to summarize for the committee the application of this research and development and to give you our views on the next steps that can be taken in this field. I shall be discussing the work of the many organizations, companies, and government agencies who have invested and funded the programs that have lead to today's capabilities.

BACKGROUND

Over the past few years, deregulation has caused reshaping of the airline industry. For the first time, carriers have been given the opportunity to define their own route structures. Passenger demand has become the governing factor as to the type of air service a community

will receive. Accordingly, the commuter/regional airline sector has expanded to fill the void that would not support larger jet traffic. FAA forecasts show a 9.3 percent annual increase for commuter RPMs to the year 1995. Deregulation has set the stage for an expansion of the aviation industry, and regardless of any recessionary economic trends, we are now starting to become aware of the problems associated with an expanding industry.

The exchange of passengers at a regional hub airport provides the best tool for an efficient passenger routing. However, accessibility to the hub airport can be somewhat less than efficent, given the increasing demands and the saturation of terminal airspace by such a wide variety of air traffic. Operators are expected to endure the price of air traffic delays. Yet the traveller demands a more efficient access not only to major hub airports, but at the remote, small community airports where his journey may either begin or end. The problem of increasing airport capacity while maintaining a high level of safety becomes very real.

Problems of over-congested airports and airspace are not new to the industry. In the past, the addition of new runways or larger aircraft seemed to have solved any overcrowding problems. Today's advances in aircraft and avionics technology can play an important role in increasing capacity. De Havilland has been very involved

in the development of special procedures which can provide a solution to air traffic problems of today. The company has emphasized their efforts on utilizing STOL performance characteristics in conjunction with 3-D area navigation and the more versatile precision navigational capabilities of the microwave landing system. By combining advanced navigational packages with an aircraft such as the Dash 7, a vehicle is produced that can go beyond the boundaries of conventional traffic flows and provide its own direct access to a major hub airport. Fuel savings and time saving are experienced by the customer, but more importantly, traffic flows are enhanced by a safe and efficient STOL procedure.

HISTORY

De Havilland has not been the first to investigate STOL/RNAV techniques. Congestion problems during the mid sixties prompted the Northeast Corridor Air Traffic Investigation. In 1968, Eastern Airlines and McDonnell Douglas conducted some experiments using a Breguet 941S renamed a McDonnell Douglas Model 188E STOL (Fig. 1) and a Decca 3-D area navigation. By using the navigational equipment on board the aircraft, a special approach procedure was designed so as to lead the aircraft onto a portion of one of the runways not being used for the general flow of traffic into the airport. The aircraft would land and, if required, stop short of the major intersecting runway in

use. Over 160 simulated IFR approaches were conducted at Boston, La Guardia, and Washington National Airport. Using the same equipment and methodology, American Airlines investigated other airports in their Inter-Metropolitan Evaluation. Both studies concluded that airport capacity could be substantially increased with no new investment in new runway construction or navigation and approach aids. The demonstrations were a success yet, at the time, the equipment that was being used did not lend itself to a practical passenger operation. The concept needed further investigation.

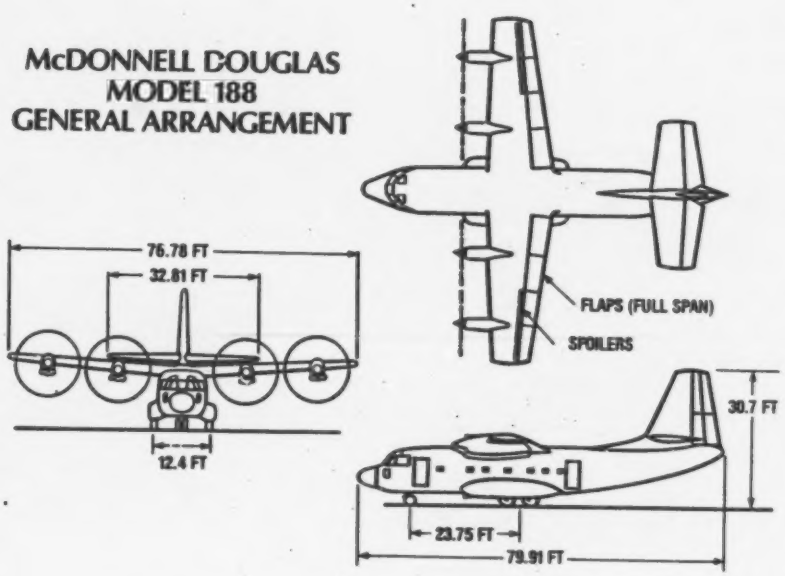

Figure 1

A few years later, de Havilland decided to resurrect the Northeast Corridor experiment but this time emphasizing STOL service as a means of accessing smaller airports or STOLports located close to the heart of metropolitan centres. Airtransit was a demonstration set up by Transport Canada with the help of de Havilland in 1974-1976. A fleet of specially designed Twin Otters were equipped with 3-D area navigation and Microwave Landing Systems. Dedicated corridors and approach routings were established for the aircraft that flew between downtown airports located in Ottawa and Montreal. Again STOL technology coupled with both RNAV and MLS had provided a solution and a convenient alternative to the travelling public.

Other operators were beginning to experiment with STOL applications. In Colorado, Rocky Mountain Airways were developing ways of more reliable service into the mountains by using MLS and the steeper descent gradients of the Twin Otters.

It was becoming evident that STOL technology was providing a greater means of accessibility. De Havilland foresaw the requirement for a true airliner quality vehicle that would provide even greater STOL performance than what was available in the Twin Otter. The aircraft would have four engines to provide greater engine-out and climb-out performance. It would have steep descent capabilities of over 7 degrees in IFR conditions.

Passenger comfort would not be neglected in the 50-passenger aircraft with full stand-up cabin and four-abreast seating. Finally the aircraft would be fully equipped with the latest avionics including a 3-D RNAV system and provisions for MLS. In November 1977, the first Dash 7 was delivered to Rocky Mountain Airways. Almost immediately, the Dash 7 was providing service to mountainous communities, where until Dash 7 came along, reliability of service was lacking.

The introduction of the Dash 7 (Fig. 2) provided the ultimate STOL capabilities coupled with microprocessor RNAV avionics and the latest MLS equipment.

DASH 7 Three View

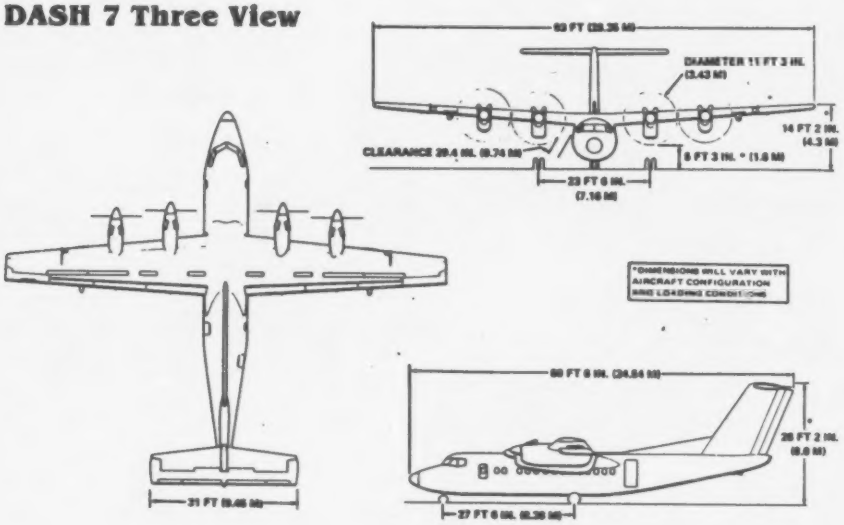

Figure 2

Moreover the aircraft was designed to be one of the most economical and practical airliners to operate. What may have been lacking in earlier STOL demonstrations the Dash 7 had provided.

TODAY

What was once an experiment in the Northeast Corridor has now become a daily routine for Ransome and Henson Airlines' Dash 7s at Washington National Airport. The Separate Access Landing System (SALS) is a STOL/RNAV approach procedure designed for the Dash 7. It has been based on Eastern's studies with the Breguet 941S in the late sixties and operates on the same principle. The Dash 7 uses a DAC-7000 3-D RNAV computer. It can accommodate up to 200 waypoints in a non-volatile memory and automatically transitions itself between each of those waypoints. The system is fully coupled with the autopilot so that any enroute navigation or approach routing is fully automated for the flight crew.

In designing the approach to runway 33 at Washington National, all waypoints were selected and placed in a fashion so as to provide the proper vertical and lateral separation from the primary vectored flow of traffic into National Airport. The RNAV computer automatically guides the aircraft through a separate and discrete corridor and onto a stub or secondary reliever runway where the aircraft

stops short of the major intersecting runway in use (Fig. 3). At Washington National Airport, Dash 7 operators have been landing on runway 33 when the active runway in use for primary jet traffic is runway 36. The aircraft approaches simultaneously with landing jet traffic on a converging approach to runway 36 (Fig. 4). In almost five years of operation, there has not been one incident pertaining to this operation.

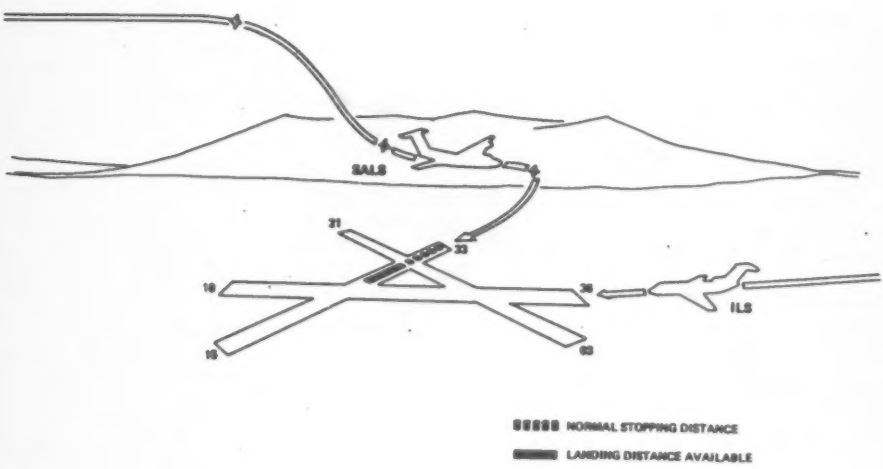

Figure 3

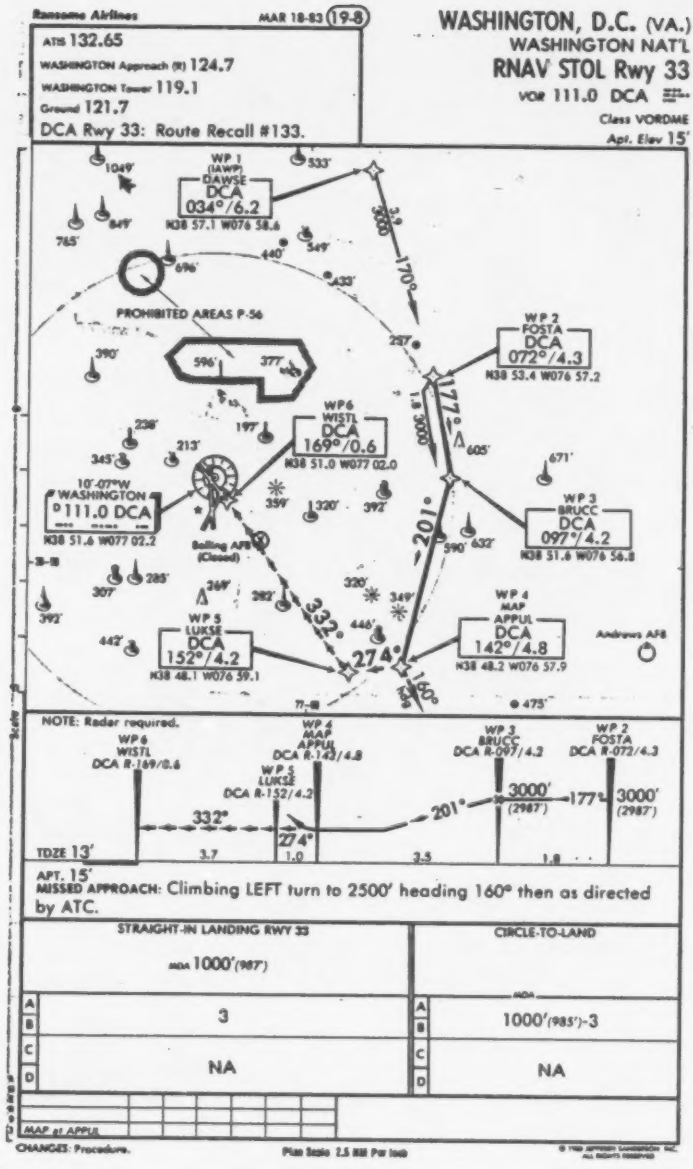
Ransome Airlines
MAR 18-83 (19-8)
ATIS 132.65
WASHINGTON Approach (R) 124.7
WASHINGTON Tower 119.1
Ground 121.7
DCA Rwy 33: Route Recall #133.
WASHINGTON, D.C. (VA.)
WASHINGTON NAT'L
RNAV STOL Rwy 33
VOR 111.0 DCA
Class VORDME
Apt. Elev 15'
WP 1 (IAWP) DAWSE DCA 034°/6.2 N38 57.1 W076 58.6
WP 2 FOSTA DCA 072°/4.3 N38 53.4 W076 57.2
WP 3 BRUCC DCA 097°/4.2 N38 51.6 W076 56.8
WP 4 MAP APPUL DCA 142°/4.8 N38 48.2 W076 57.9
WP 5 LUKSE DCA 152°/4.2 N38 48.1 W076 59.1
WP6 WISTL DCA 169°/0.6 N38 51.0 W077 02.0
10°-07°W WASHINGTON 111.0 DCA N38 51.6 W077 02.2
PROHIBITED AREAS P-56
Bolling AFB (Closed)
Andrews AFB
332°
274°
201°
177°
170°
160°
3000'
NOTE: Radar required.
WP6 WISTL DCA R-169/0.6
WP 5 LUKSE DCA R-152/4.2
WP 4 MAP APPUL DCA R-142/4.8
WP 3 BRUCC DCA R-097/4.2
WP 2 FOSTA DCA R-072/4.3
3000' (2987')
TDZE 13'
APT. 15'
MISSED APPROACH: Climbing LEFT turn to 2500' heading 160° then as directed by ATC.
STRAIGHT-IN LANDING RWY 33
MDA 1000'(987')
CIRCLE-TO-LAND
A 3
B 3
C NA
D NA
A 1000'(985')-3
B 1000'(985')-3
C NA
D NA
MAP at APPUL
CHANGES: Procedure.

Figure 4

The SALS concept has proven itself at National Airport and has set a precedent for applications at other hub airports. Ransome Airlines have either looked at or developed approaches to JFK and Newark in New York, Philadelphia International and Boston's Logan International. A second Washington National approach has been designed for Henson Airlines along with five other procedures for Baltimore-Washington International. Other SALS approaches have been designed for Rio Airways at Dallas-Fort Worth Regional Airport, Golden West Airlines at San Francisco International, and Air Wisconsin at O'Hare International.

In 1980, the Service Test and Evaluation Program (STEP) was established in order to gain operational and procedural experience with the new Microwave Landing System. Ransome's SALS approach procedure onto runway 33 at Washington provided a perfect opportunity to assess the feasibility of incorporating a precision approach navaid into the SALS procedure. Hence an MLS was installed at the end of runway 33 at DCA. The RNAV procedure leads the aircraft onto the centreline of the MLS approach where a 6-degree glidepath is intercepted, leading the aircraft onto the runway 33, stopping short of 36.

Other applications of STOL/MLS procedures have been developed using FAA interim STOL criteria (order 8260.30). Rocky Mountain Airways have developed MLS/STOL approaches into Aspen, Steamboat Springs, and Vail, Colorado. All procedures use glideslope angles in excess of 6.5 degrees

and have been designed to take advantage of a steeper than normal climb-out capability.

The latest MLS/STOL approach procedure to be certified is located at Valdez, Alaska. This approach uses a 6.2-degree glideslope and reduces the landing minima from 3,000 feet/ 5 miles for conventional aircraft to 500 feet / 3/4 miles for STOL aircraft (Figs. 5 and 6).

Figure 5

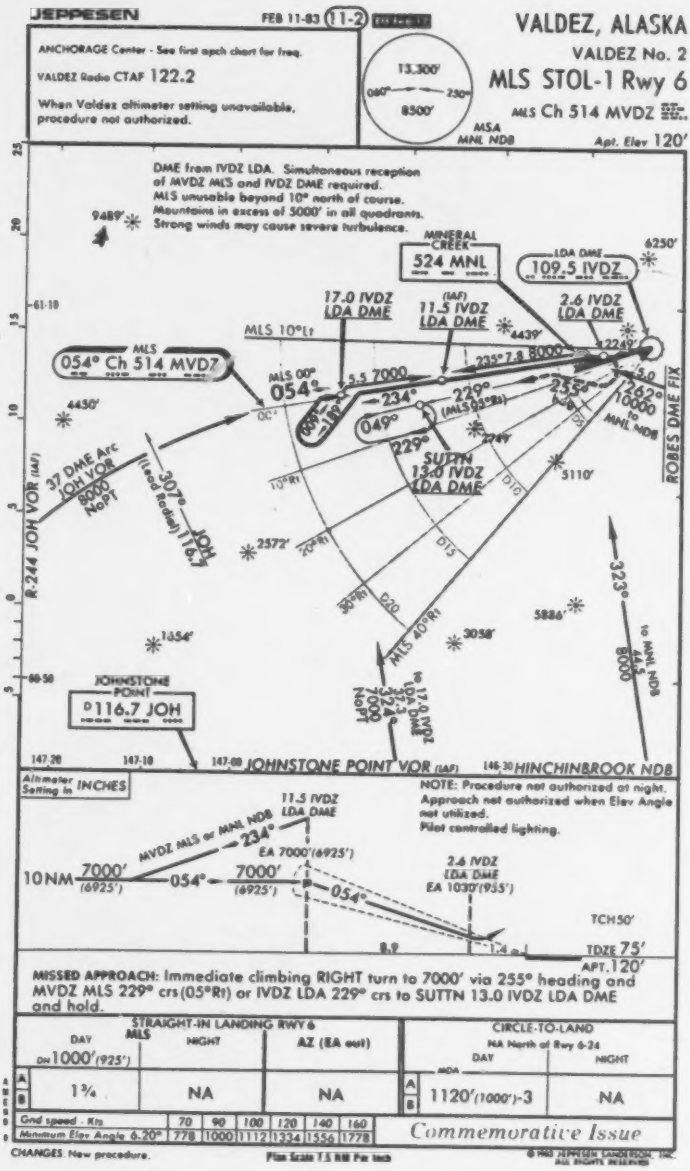
JEPPESEN
FEB 11-83 (11-2)
VALDEZ, ALASKA
VALDEZ No. 2
MLS STOL-1 Rwy 6
MLS Ch 514 MVDZ
ANCHORAGE Center - See first apch chart for freq.
VALDEZ Radio CTAF 122.2
When Valdez altimeter setting unavailable, procedure not authorized.
13,300'
060°
230°
8500'
MSA
MNL NDB
Apt. Elev 120'
DME from IVDZ LDA. Simultaneous reception of MVDZ MLS and IVDZ DME required.
MLS unusable beyond 10° north of course.
Mountains in excess of 5000' in all quadrants.
Strong winds may cause severe turbulence.
MINERAL CREEK
524 MNL
LDA DME
109.5 IVDZ
6250'
17.0 IVDZ LDA DME
(IAF)
11.5 IVDZ LDA DME
2.6 IVDZ LDA DME
MLS 10°Lt
MLS
054° Ch 514 MVDZ
MLS 00°
054°
5.5 7000
235° 7.8 8000
234°
229°
(MLS 05°Rt)
049°
255°
262°
10000
to MNL NDB
SUTTN
13.0 IVDZ LDA DME
ROBES DME FIX
37 DME Arc JOH VOR 8000 NoPT
307° (Lead Radial) JOH 116.7
R-244 JOH VOR (IAF)
10°Rt
20°Rt
30°Rt
D10
D15
D20
MLS 40°Rt
323°
to MNL NDB
44.5
8000
JOHNSTONE POINT
D116.7 JOH
JOHNSTONE POINT VOR (IAF)
HINCHINBROOK NDB
Altimeter Setting in INCHES
NOTE: Procedure not authorized at night.
Approach not authorized when Elev Angle not utilized.
Pilot controlled lighting.
MVDZ MLS or MNL NDB
234°
EA 7000'(6925')
10NM
7000'
(6925')
054°
2.6 IVDZ LDA DME
EA 1030'(935')
TCH 50'
TDZE 75'
APT. 120'
MISSED APPROACH: Immediate climbing RIGHT turn to 7000' via 255° heading and MVDZ MLS 229° crs (05°Rt) or IVDZ LDA 229° crs to SUTTN 13.0 IVDZ LDA DME and hold.
STRAIGHT-IN LANDING RWY 6
MLS
DAY
NIGHT
AZ (EA out)
CIRCLE-TO-LAND
NA North of Rwy 6-24
DAY
NIGHT
DH 1000'(925')
1¾
NA
NA
MDA
1120'(1000')-3
NA
Grnd speed - Kts
70
90
100
120
140
160
Minimum Elev Angle 6.20°
778
1000
1112
1334
1556
1778
Commemorative Issue
CHANGES: New procedure.
Plan Scale 7.5 NM Per Inch

Figure 6

STOL/RNAV/MLS procedures have proven to be operationally feasible and provide the potential to reduce terminal and enroute air traffic congestion while increasing airport capacity. Moreover MLS plays an important role in providing a safe IFR procedure for remote airports whose accessibility is hindered because of topography.

The benefits evolving from these procedures become evident with experience that has been gained on approach concepts like SALS. For example, at Washington National there has been testimony to the effect that SALS actually reduces ATC workload. Normally the controller would provide heading and altitude direction to the pilot in order to mesh the aircraft into the general flow of traffic. With the SALS procedure, the on-board RNAV computer is doing most of the work for the controller by providing its own vectored approach path to the runway. It is a dedicated approach which has been planned so as to remain separate from the conventional flow of traffic into the airport. The controller need only monitor the progress of the SALS approach leaving more time for him to deal with other traffic.

By routing Dash 7 traffic through a SALS approach and because the SALS operation is independent of the conventional routing, there is an extra slot which becomes vacant on the conventional arrivals route for every SALS approach being performed (Fig. 7). Hence

there is potential for expanded airport capacity by filling those vacated slots with conventional jet traffic and continuing to route all Dash 7 traffic through the SALS approach procedure (Fig. 8).
At Washington National, if SALS is used to its ultimate potential, there is reason to believe that airport capacity could increase by over 5 percent.

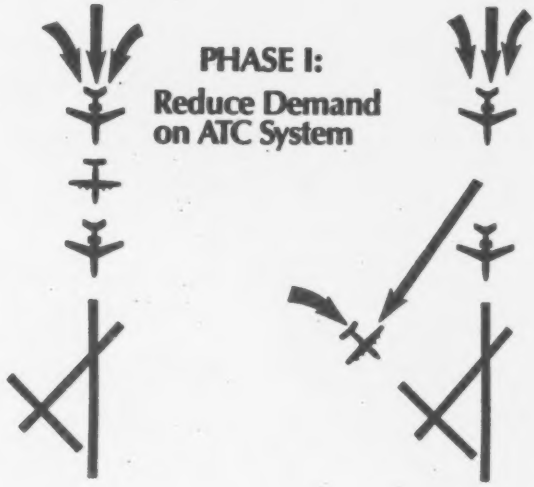

Figure 7

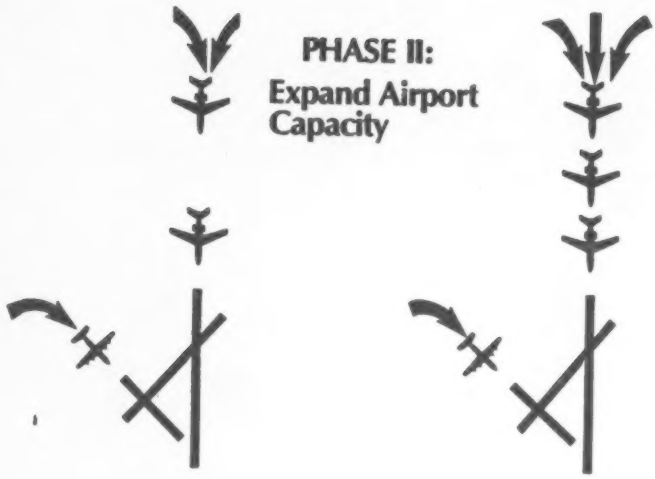

Figure 8

For the operator, the SALS concept can save time and money. Normal traffic flows can be restrictive and require traffic to be vectored 20 miles beyond the airport in order to adhere to proper spacing requirements. At Washington National, Ransome and Henson Airlines are experiencing a 15 percent less fuel burn and a 10-minute time saving on their Philadelphia to Washington routes as a result of the SALS procedure (Fig. 9), based on current flight frequency that translates into an annual saving per Dash 7 of 40,000 gallons of fuel.

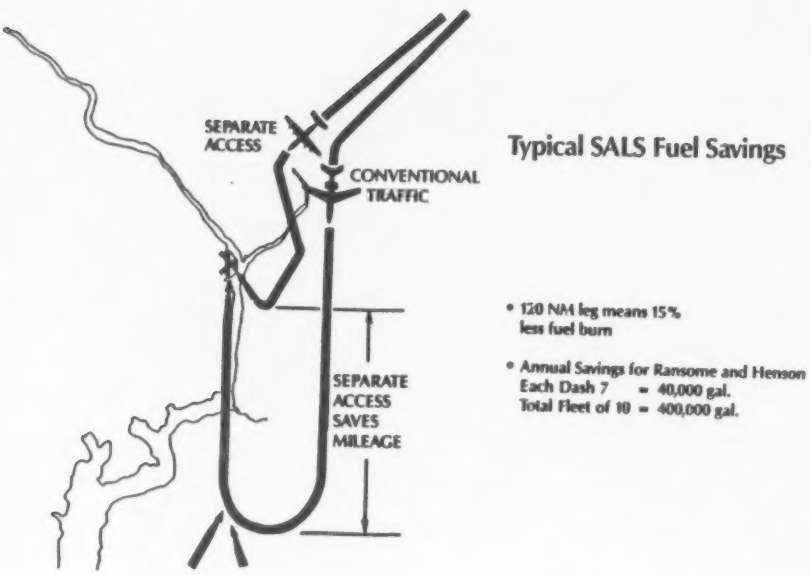
SEPARATE ACCESS
CONVENTIONAL TRAFFIC
SEPARATE ACCESS SAVES MILEAGE
Typical SALS Fuel Savings
• 120 NM leg means 15% less fuel burn
• Annual Savings for Ransome and Henson
Each Dash 7 = 40,000 gal.
Total Fleet of 10 = 400,000 gal.

Figure 9

For the passenger, STOL/MLS/RNAV procedures enhance accessibility to both major hub airports and remote destination airports. Safety and reliability are maintained while providing enough flexibility to traverse a busy terminal airspace or navigate into a deep mountain valley. The Dash 7 STOL procedure

addresses a wide passenger market spectrum and satisfies the demands of a more discerning travelling public.

In summary, STOL/MLS/RNAV techniques provide an extra dimension to the airspace system. Currently all SALS procedures are being conducted to VFR limits. Even at that, the benefits provided to ATC and operators are considerable. The potential for even greater benefits are present, if regulations can be formulated to specifically address special procedures such as SALS and MLS/RNAV. The procedures are certainly not new to the industry and, over the last few years, have proven themselves operationally feasible. We now have the tools to enhance the efficiency of a growing ATC network, if we choose to use them.

FUTURE

Traffic forecasts projected over the next 20-year period all point toward increasing passenger growth. Deregulation seems to have guaranteed this trend and skewed the expansion towards the commuter/regional airline market. Communities will be served by smaller aircraft with greater frequency. Recent FAA forecasts show a 4.5 percent annual growth of the commuter carrier fleet size to the year 1995. That compares with a 2.2 percent growth

for the air carrier fleet size over the same period. Increasing aircraft movements coupled with a growing passenger market will saturate air traffic control facilities at all major hub airports. FAA workload forecasts are projecting an increase in total aircraft operations from 57.2M for 1984 to 95.6M in 1995. Already centres such as New York, Chicago, and Los Angeles are having to deal with capacity problems by regulating access to certain airports through slot allocations.

In the summer of 1982, the Administrators' Industry Task Force on Airport Capacity Improvement and Delay Reductions put forward their recommendations for short-term solutions to the increasing problem of airspace congestion. Among those recommendations was an item which cited the importance of developing a converging IFR approach procedure using STOL/RNAV techniques as a means of increasing airport capacity.

The Task Force made specific reference to the RNAV procedures being used by Ransome at Washington National as an operational example of what could be done in IFR conditions given the development of proper criteria. Given the degree of success that has been experienced with

the SALS procedure at Washington under VFR conditions, most agree that a simultaneous, independent converging IFR approach procedure is possible using STOL/RNAV and/or MLS approach techniques. As a result of the Task Force's recommendation, a proposal has been put forward to lower the limits on the procedure below VFR to 600 feet and 1.7 miles visibility (Fig. 10). Other aspects have yet to be addressed such as allowing simultaneous stub runway landings on a wet runway surface.

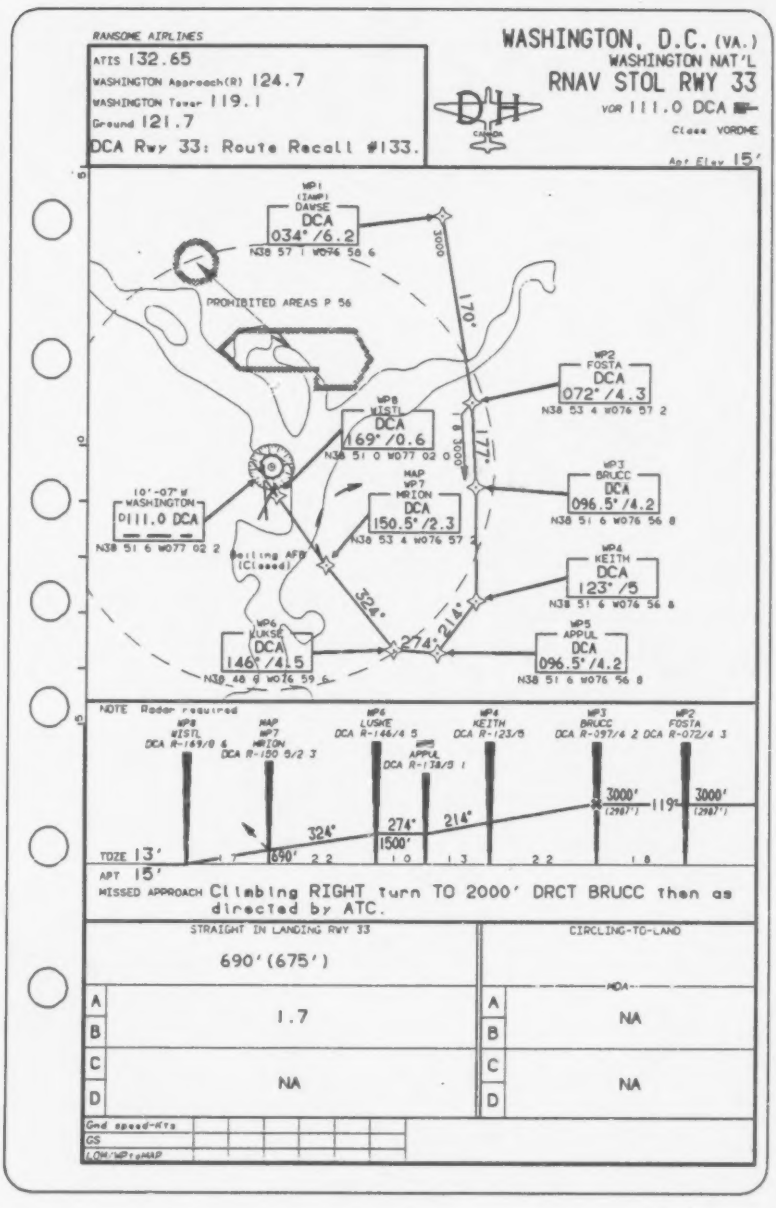
RANSOME AIRLINES
ATIS 132.65
WASHINGTON Approach(R) 124.7
WASHINGTON Tower 119.1
Ground 121.7
DCA Rwy 33: Route Recall #133.
WASHINGTON, D.C. (VA.)
WASHINGTON NAT'L
RNAV STOL RWY 33
VOR 111.0 DCA
Class VOR/DME
Apt Elev 15'
WP1 (IAWP) DAWSE DCA 034°/6.2 N38 57 1 W076 58 6
PROHIBITED AREAS P 56
WP2 FOSTA DCA 072°/4.3 N38 53 4 W076 57 2
WP8 WISTL DCA 169°/0.6 N38 51 0 W077 02 0
MAP WP7 MRION DCA 150.5°/2.3 N38 53 4 W076 57 2
WP3 BRUCC DCA 096.5°/4.2 N38 51 6 W076 56 8
WP4 KEITH DCA 123°/5 N38 51 6 W076 56 8
WP5 APPUL DCA 096.5°/4.2 N38 51 6 W076 56 8
WP6 LUKSE DCA 146°/4.5 N38 48 6 W076 59 6
10°-07° W
WASHINGTON D111.0 DCA
N38 51 6 W077 02 2
Bolling AFB (Closed)
170°
177°
324°
274°
214°
3000
NOTE Radar required
WP8 WISTL DCA R-169/0 6
MAP WP7 MRION DCA R-150 0/2 3
WP6 LUKSE DCA R-146/4 5
APPUL DCA R-138/9 1
WP4 KEITH DCA R-123/6
WP3 BRUCC DCA R-097/4 2
WP2 FOSTA DCA R-072/4 3
3000' (2987')
119
3000' (2987')
1500'
690'
2.2
1.0
1.3
2.2
1.8
TDZE 13'
APT 15'
MISSED APPROACH Climbing RIGHT turn TO 2000' DRCT BRUCC then as directed by ATC.
STRAIGHT IN LANDING RWY 33
690'(675')
CIRCLING-TO-LAND
MDA
A 1.7
B
C NA
D
A NA
B
C NA
D
Gnd speed-Kts
GS
LOM:WP1;MAP

Figure 10

Development of criteria for an IFR SALS approach at National is slowly being addressed. However, it is important to note that SALS is a concept that can be a most useful tool for alleviating terminal congestion at almost every hub airport in the U.S., if not the world. Currently the criterion being used will not sufficiently recognize the performance characteristics of STOL aircraft and the more accurate tracking capability of today's avionics equipment. General guidelines and/or criteria must be provided for the SALS concept so that all potential hub airports can realize its benefits.

Recently de Havilland Aircraft was asked by the FAA's MLS project team to participate in the collection of MLS/STOL approach performance data. This is required for the development of a new MLS/STOL approach performance data. This is required for the development of a new MLS/STOL approach criteria which will supersede the interim criteria that have been in place since 1977. A number of MLS/STOL approach procedures will be test flown by a sample group of pilots using a specially equipped Dash 7 aircraft. The data obtained from these test flights will ultimately determine the protected airspace required for an MLS/STOL procedure of 6 degrees, plus or minus 2 degrees. Although the test program

will address MLS/STOL procedures, it will not address RNAV/STOL procedures or criteria pertaining to a simultaneous, independent, converging approach scenario. Development of STOL criteria in conjunction with RNAV equipment is essential to the further development of SALS. Ultimately the development of a more accurate MLS/RNAV capability coupled with STOL performance will allow efficient, time-saving segmented and curved precision approach procedures well beyond the capabilities of most conventional aircraft.

It will be the further development of STOL IFR procedures that will result in direct benefits to both ATC and operators alike. The STOL approach concepts in use today have proven that the equipment is capable of performing to IFR limits well beyond what are currently being accepted today. By providing a catalyst for regulatory processes to evolve and catch up with the technology available to us, we can provide a new solution with which to address the increasing demands of a growing air traffic control system.

The groundwork for STOL/MLS/RNAV approach procedures has already been demonstrated. Let us follow through with the establishment and development of the rules and regulations that will provide a real benefit to the industry.

SUMMARY

Over the past few years, de Havilland Aircraft has been working with both our operators and civil aviation authorities towards the development of STOL/RNAV/MLS procedures. Approach concepts such as the Separate Access Landing System at Washington National and the STOL/MLS approach at Valdez, Alaska, are operational as a result of our joint efforts. The experience that we have gained from these procedures is twofold:

1. We have proven that both the avionics and airframe technology are reliable, efficient, and accurate enough to support the special procedures by which the equipment has been designed.
2. The STOL/RNAV/MLS procedures have been proven operationally feasible as a safe and efficient means of increasing airport accessibility.

To date, STOL/RNAV/MLS procedures have had limited application. Yet the above two points indicate the adaptability for application and virtually any limited access airport in the U.S. For a broader use of STOL/RNAV/MLS applications and in order to solve an increasing problem of congestion and accessibility at many of today's airports, there are three major steps to be taken:

.../25

1. Develop an approach criteria and regulations that will specifically address special approach procedures using STOL/RNAV/MLS techniques. The criteria should incorporate concepts like SALS (converging, simultaneous, independent approach procedures), steep gradient approach and missed approach paths, precision missed approach guidance capabilities, and segmented and curved approach paths using MLS/RNAV guidance.
2. For congested hub airports, determine the feasibility of SALS applications, paying particular attention to those airports approaching their maximum capacity. Investigate the use of reliever runways, stub runways, and/or taxiways that could be used for a STOL runway at each potentially congested centre.
3. For remote or high terrain airports, proceed with the implementation of MLS, paying particular attention to the airports where MLS can expand or initiate service as a result of STOL/MLS procedures.

In the next 10-year period, traffic forecasts for the U.S. show that as many as 25 airports will be experiencing air traffic volumes at or beyond their saturation points. The National Airspace System Plan has addressed the growing problem of congestion by proposing to re-equip the ATC facilities with a modern system capable of handling greater volumes of air traffic. Yet the congestion problem is of an imminent nature and it is essential. It is essential we address these traffic congestion problems now. The above three steps represent a logical transition from concepts that have already proven their worth in reducing congestion and increasing accessibility. We already have a solution we can use; now we must implement it.

Mr. GLICKMAN. Thank you.

I'm just going to ask a couple of questions because we have a long panel today, but following up on Mr. Sandford's last point, I'd like to ask all of you this same question: Are we moving ahead with this technology that you have talked about today as fast as we should be. Is the FAA retarding movement in all of these areas? And I thought you might each want to comment on this. We're going to be spending billions of dollars on modernizing this system and—but there are some things that we could be doing now. There are some technical changes that will require a lot of money. Are we moving ahead as fast as we ought to be?

Mr. BOWE. I might comment first, Mr. Chairman, we believe that the—the equipment technology is here. As Mr. Sandford mentioned, the equipment, the computer technology, the things that we need to build this equipment exist today. We don't—we don't believe we're being held up by anybody, but we do believe that we must be a part of this major planning that's going on so that the—so that this equipment can get properly applied and that it doesn't get applied, as you said, on an ad hoc basis.

Mr. GLICKMAN. Mr. Miller.

Mr. MILLER. That involves, of course, operational considerations, funding and so forth. The technology itself is here, as was pointed out. The production capability is here. We'll be producing in a relatively short time five or six systems per month. We could double or triple that quite easily so if the operational need was greater, we could respond faster.

My concerns would lie in the area of the application of the procedures and such that would allow you to more effectively use those products as they're introduced. And I'd also mention that there is a marketplace right now that is not being satisfied by the FAA program because of its timing and we are very aggressively pursuing that with our non-Fed systems for those early users, so we see an increasing demand in the marketplace which we would intend to satisfy, either through the FAA program or directly.

Mr. GLICKMAN. Do you—before I get to you, Mr. Sandford—let me ask: Do either of you gentlemen think that the operational problems currently confronting the FAA in terms of the congestion in the air traffic system is in any way retarding their ability to move ahead with some of the changes that you gentlemen have talked about, technical changes?

That is, are they so preoccuppied with the fact that O'Hare and Atlanta and St. Louis are jammed up and some of the mundane day-to-day things just to keep that traffic going that—and with perhaps being understaffed in controllers that they can't get through this forest to the new things that might help in the long term?

Anybody have any thoughts on that?

Mr. MILLER. I would think that that would be having some impact, although we do see fairly good separation between the operational issues of today versus the operational issues of implementing equipment in the future. To carry that one step further, however, and I didn't mention it earlier, the lower minimums that are inherently available from MLS will greatly facilitate the flow of traffic, and I didn't comment on that earlier.

Mr. GLICKMAN. Mr. Sandford.

Mr. SANDFORD. Mr. Chairman, I think you're on a rather key point. I would add to the "Are we ready; are we moving fast enough?" I would add to that—you know, you have mentioned the preoccupation, but also, we are small guys that are working this. I mean, I run a small company. The airlines that run this are small. It's regrettable that the people who are thrusting this technology are not the Eastern Airlines and the Boeings and the McDonnell Douglases that are thrusting this particular application we're talking about because they—they have the resource and the horsepower to push it. So it needs the help of a committee like yours, I think, to increase the emphasis on it because I think it is—large percentages of our resources get expended against these things so that's an additional dimension.

Now let me just say regarding are we dragging our feet collectively, I would say that if you ask that question a year from now and the pace is the same it is today, I would have to say yes. But in defense of the past 5 years, I think it's been going at an appropriate speed. We have to recognize that we were doing something new. Introducing something new is always difficult, particularly difficult when it involves safety. But a 5 years now of a record of doing it, I believe we can now say we have passed the experimental phase or the early introduction phase or whatever you want to call the phase we've been through. We now should move into a phase of broad application and that's what we're saying.

That is, to—and that broad application can come by standardizing the techniques to create an environment in which people look at the individual solutions at airports, rather than the companies having to do it. There should be, in my opinion, already a potential for every major airport in the country for separate access reliever runway approach to increasing capacity if the operators want to use it, and give the operators the incentive of being able to be broken away from the normal slot patterns and they will pay the money to retrofit that aircraft. We are dealing with one airline right now who's looking at retrofitting 10 aircraft because he sees a potential of being able to have free access to one of the major hubs.

Thank you.

Mr. GLICKMAN. Let me just ask a couple brief quick questions. Mr. Miller, when will curved approaches be available?

Mr. MILLER. Technically, curved approaches are available today. The equipment to perform the mathematical functions is there. We get into a very involved process of operational procedures, pilot training, and just how do you apply these things. The closest thing we have today which comes relatively easy is the segmented approach, which is a fairly efficient step forward. The RTCA Special Committee 151 is looking at both curved and segmented approaches to establish minimum standards for those, and that will have to be, of course, integrated with the FAA's operational ability to absorb that, but today, the equipment is there that can give you curved approaches.

Mr. GLICKMAN. Mr. McCandless.

Mr. MCCANDLESS. Thank you, Mr. Chairman.

I appreciate the opportunity of you gentlemen sharing your information with us this morning. I listened with a great deal of interest because—[audio feedback]—the subcommittee chairman is

from one of the leading areas of aviation—[audio feedback]—this is the Science and Technology Committee, too. [Laughter.]

I find a certain ironic conflict in the general statements and information if one takes it and puts it into some kind of bowl and begins to stir it—as the chairman said to begin with, we want increased capacity; we want to reduce our delay and yet we want to, in doing this, maintain the safety of what we have in the way of a system with the current system versus onboard technology in airline scheduling.

I had a particularly interesting experience not too long ago. Midday in Salt Lake City, which has never appeared to me to be a big, bustling, ongoing field—maybe I'm in error—we were number—I don't remember what it was, but there were lined up waiting to take off after we did, 13 aircraft, 11 of which were Western, which indicated to me by the scheduling that they all came in and all left in the particular part of time that everybody sat around holding one another's hands for a great deal of the balance of the day, which would indicate that it would be difficult to accept on the face value the need to put three more runways in a given airfield because of that type of scheduling. Yet we say the onboard technology is in the newer aircraft.

However, DC9's and 727's will be around quite some time if we look at the history of aircraft and their cost. And onboard technology is, if I understood the testimony correctly, difficult by many standards to justify the cost.

What we're interested in—I am—I'm interested in going out to Dulles, getting on a plane and not sitting at the end of the runway 45 minutes with nobody around and landing at LAX and then I'm not interested in sitting before we push off at LAX for 45 minutes before we go out to the end of the runway.

You've covered these areas of STOL navigation flight systems. Where are we? How do we put all of this together in this mixture that I talked about, stir it up and come up with a solution to the problem that one can point a direction to based upon what you've shared with us in the limited time we've been together this morning?

Any of you or all of you wish to answer?

Mr. MILLER. I'll take a brief crack at it. We're clearly in a transition phase now from an existing system to new generation of equipment which will offer a tremendous improvement in the ability to do the things we're talking about, provide more traffic flow more efficiently and you're not going to see the results of that operationally for several years.

In my opinion, the sooner you can get the newer equipment in the field, the better, because the sooner you can start addressing how do you use these in developing the procedures and the policies that will allow you, then, to take full advantage of the systems when they come out in full production.

Mr. BOWE. Mr. McCandless, we might add to that in saying that the technology, as we've said, exists, but we—and as I pointed out to—in my talk—was, we really do need to work closer with the planners of the national airspace because normally we talk about what you can do with this type of equipment and the No. 1 concern

is, well, but you're mixed in with other traffic that doesn't have this capability.

So we need to work closer with "how do we handle this mixed environment," but also, if an airplane is equipped, then how can they benefit the system and how may they benefit by the system and thereby maybe give more of a incentive to people—for people to put this equipment on the airplane, and the more people that we get equipped with these types of systems, then I think it can have a very definite positive impact on the air traffic control system.

Mr. McCANDLESS. Let's say that I'm Brand X Airline; that I have an aggressive management program; that I've watched these slides; I see the savings in fuel costs by retrofitting a current plane with a certain type of flight or navigational accommodation of both systems. Yet, your comment was that the costs appear to be prohibitive from certain points of view.

If I bought a DC9 driven from a little old pilot from Pasadena, for example, for my airline, and the life expectancy of the DC9 in the mode in which it was going to be used had a certain length of years, what am I talking about in terms of today's initial cost for that airline—or for that airplane—and what it would take to retrofit it to get these savings that we're talking about in the way of fuel costs?

Mr. BOWE. Typically, most of the airlines that we talked to want to get a payback on their investment in 1 year. They want to buy this equipment and then have it pay for itself within 1 year—1 to 2 years, and then start making money off of it. And so the length of time that they plan to keep their airplane becomes a key factor in that decision.

Mr. McCANDLESS. What would that DC9's life expectancy be for the average airline? In service within their system?

Mr. BOWE. I think there are—I'm not an expert in that area, but there are many airplanes in the DC9 class which have been in operation for quite some time. We do know of a recent conversation which we have held with an international carrier, SAS, and they plan to keep their DC9's for another 10 years, so they are making some rather major investment in avionics and in equipment to extend the life of that airplane for another 10 years.

The brand new DC9-80's that are being sold in that class of airplane, I am sure, have a—you know, a very long life. Maybe there are other—somebody here that could better address that than I.

Mr. McCANDLESS. If I were purchasing now the new 80, which I think is—just from a passenger point of view, a pretty fine airplane—why wouldn't I want this regional navigation flight system? You say it's not standard, but I guess it possibly would be available, but yet, it would not be a retrofit type of situation?

Mr. BOWE. Yes. The equipment right now—and I may be mistaken, but I don't believe McDonnell Douglas offers an area navigation system as standard. They do offer a performance management system on that aircraft, but the—normally, if you're buying a new aircraft and the air framer and the manufacturers have made an investment so as to come up with a system for that airplane and then it's much easier to sell the airlines on accepting that equipment in the airplane.

And I would say that the new-technology airplanes have began to prove that area navigation and performance management really do pay for themselves and so it's much easier to sell these systems today, let's say, than it was 7 or 8 years ago. So there is a keen interest in it, but they also want some assurance that they're going to be able to gain that fuel savings because key to saving that fuel is, will the air traffic control system let us use it? Because to make those savings, we have to be able to fly the airplane at certain speeds that are optimum for my particular airplane on my particular day that I'm flying, so we need that flexibility of being able to fly speeds and paths that are optimum for this aircraft and that has to be integrated with the air traffic control system.

That's why we stress we really do need to be working with the FAA in their future planning.

Mr. MCCANDLESS. One more final question, if I may, Mr. Chairman, we talked about the—reaching the capacity of these various airports that were listed there, which LAX was one. Given this technology and the implementation as soon as practical by whatever push and shove can be administered, how could you—how much could you increase the current capacity or scheduling of, say, LAX, using that as an example, or if you want to use another one that you're more familiar with? What percentage are we talking about that this would enhance the existing concrete's operation?

Mr. SANDFORD. Let me try that one if I might, Mr. McCandless. Let me first specify the qualifiers. Obviously, you have to have the equipment there that can operate on it. But let's take, first of all—the arithmetic becomes very simple. Let's take a simple, two-cross runway. If the main traffic is going on, let's say, the north/south runway, you can use half of the east/west——

Mr. MCCANDLESS. You see, that's one of the problems at LAX. We don't have——

Mr. SANDFORD. No, no, I'll address the LAX one in just a moment if I might.

If you—I was just going to get the—the theoretical maximum.

Mr. MCCANDLESS. I see.

Mr. SANDFORD. You can double the capacity of your airport, OK, so if you are accepting, let us say, several hundred flights a day, then multiply that by two. That is the theoretical. That's not the practical. That's the theoretical.

Mr. MCCANDLESS. But let me interrupt you now. You're talking here about using STOL aircraft——

Mr. SANDFORD. Yes. Let me then take the parallel-runway approach, LAX, which is classic. You can take a runway and use the first half of the runway for arrivals and the second half of the runway for departures because you've got—well, actually you can use it four times—runway four times over. I mean, you wouldn't, but there is that much—because it only takes 2½ thousand feet. If you've got 10,000 feet, then you can, on that same piece of concrete, double it.

Now, we were taking extremes. If you open it up to 4,000 foot of runway, which certainly you can then get two on 4,000 foot of runway, then you've got more aircraft that can get in there.

Now, you know, putting two on the same runway is totally practical. I'm not sure that every aircraft could take advantage of that,

but let's now create a 4,000-foot reliever runway, which is currently a taxiway. Now you can take in a lot of general aviation aircraft as well as commuter aircraft.

Now, you know, the easiest thing for me to say is make everything STOL. You don't have to. Four thousand foot is not STOL. Most aircraft get in there, and as we all know, in many of the airports—I think Logan is a classic, where about half of the traffic at Logan is general aviation and commuter. So you do open up a lot of capacity. If there were more capacity here at Washington National, I'm sure that commuter and general aviation would be a larger segment of it.

I would say that in a practical sense, knowing the aircraft that are around today, that you're really talking about 5- to 15-percent increase in capacity at the airport. If the aircraft that my company builds were standard, then you can double the capacity at a given airfield.

Mr. MCCANDLESS. Thank you, gentlemen. Thank you, Mr. Chairman.

Mr. GLICKMAN. Mr. Carney.

Mr. CARNEY. Mr. Chairman, I don't have any questions of the witnesses. I would just like to apologize for being late, but I flew in from New York to Washington National.

Mr. GLICKMAN. The point is well made.

Let me just ask a couple of quick questions. What about the noise footprint from the steep approach? Is that a problem?

Mr. SANDFORD. No problem at all, Mr. Chairman. In fact, an aircraft such as the Dash 7 conducting a standard steep approach—the perceivable noise level is kept within the perimportanter of the airfield. It is a very much quieter operation, extremely quiet.

Mr. GLICKMAN. This airplane that Air Wisconsin flies, this four-engine, high-wing jet, does that have STOL characteristics or not? Do you know what I'm——

Mr. SANDFORD. Yes. It's called the BA146. No, it is shorter, but it would not match the characteristics of a Dash 7 or the turbo—some of the modern turboprops that are coming into the marketplace today.

Mr. GLICKMAN. Let me see. Mr. Bowe, has the FAA been encouraging the development of the, you know, area navigation or are they inhibiting it?

Mr. BOWE. No, I would believe that they have encouraged it. Like I say, the people that we work most directly with are the people that certify our equipment, but they are always very encouraging and I think they're excited about the application of particularly the new equipment with the map displays.

Mr. GLICKMAN. OK.

We want to thank you gentlemen——

Mr. MCCANDLESS. Mr. Chairman——

Mr. GLICKMAN. Yes——

Mr. MCCANDLESS [continuing]. If I may——

Mr. GLICKMAN [continuing]. Sure.

Mr. MCCANDLESS. I'm curious. I haven't been able to find it in any of the literature. Dash, up until recently, was a soap used in the washing machine. Does it have a long version? Does the "D" stand for de Haviland or——

Mr. SANDFORD. No—well, it is the long version, actually of—what it is, it comes off of the engineering drawings. On all of our engineering drawings, we put DH-, then the number "8," it was the eighth airplane, or this seventh airplane we designed. Then we put the rest of the parts, so we couldn't put a "ptttt" line so we tried to spell it out.

Mr. MCCANDLESS. You couldn't spell "ptttt"—[Laughter.]

Mr. SANDFORD. That's right.

Mr. MCCANDLESS. Thank you.

Mr. GLICKMAN. Thank you all very much. All good testimony. Appreciate it.

Our next panel is a panel of users. We have Mr. Frank Jensen—why don't—I'll tell you what, why don't the panel come down—Mr. Jensen, Mr. Warner, Mr. Cooke, Mr. O'Brien, and Mr. Ransome.

Why don't we go ahead and take you in the order that you are listed on the witness list; so, Mr. Jensen, we'll start with you, and again, all of your statements will appear in the record in their entireties; so if you could summarize, we would appreciate it.

STATEMENTS OF FRANK L. JENSEN, JR., EXECUTIVE DIRECTOR, HELICOPTER ASSOCIATION INTERNATIONAL; ROBERT T. WARNER, SENIOR VICE PRESIDENT, GOVERNMENT AND PUBLIC AFFAIRS, AIRCRAFT OWNERS & PILOTS ASSOCIATION; ROBERT A. COOKE, VICE PRESIDENT, OPERATIONS, NATIONAL BUSINESS AIRCRAFT ASSOCIATION, ACCOMPANIED BY MYRON W. COLLIER, MANAGER, FLIGHT OPERATIONS, CYCLOPS CORP., AND GILBERT F. QUINBY, PRINCIPAL, G.F. QUINBY ASSOCIATES; JOHN O'BRIEN, DIRECTOR, ENGINEERING AND AIR SAFETY DEPARTMENT, AIR LINE PILOTS ASSOCIATION, ACCOMPANIED BY TOM KRAMER, VICE CHAIRMAN OF OPERATIONS, AIR TRAFFIC CONTROL COMMITTEE; AND J. DAWSON RANSOME, CHAIRMAN AND PRESIDENT, RANSOME AIRLINES, ACCOMPANIED BY FRANK FOSTER, CHIEF PILOT, RANSOME AIRLINES, AND DAN SANTOR, SPECIAL ASSISTANT TO V.P., OPERATORS

Mr. JENSEN. Mr. Chairman and members of the subcommittee, I'm pleased to be here today to comment on behalf of the commercial helicopter industry regarding the operational aspects of RNAV and MLS.

I'm accompanied by HAI's director of operation, Mr. Lew Bartolotta back in the second row here.

HAI is an independent, nonprofit organization formed in 1948. Our regular members are the people who fly the helicopters primarily, civil operators, companies. The associate members are the manufacturers of helicopters, engines, components, and ancillary equipment, as well as suppliers, brokers, insurers, and service organizations. About 80 percent of our members are from the United States and it's on behalf of those people that I'm speaking today. The other 20 percent come from 40 countries throughout the free world.

We also have affiliate members. These are primarily regional helicopter associations which pertain to, for example, Texas, New

England, whatever. We have sustaining members, for a total of about 1,100 members.

We feel that we provide a really unique and valuable forum for the entire civil helicopter industry. Our regular members operate helicopters in the fields of agriculture, air carrier, construction, executive transport, law enforcement, many other important uses. All together, there are about 9,000 civil helicopters in the United States today.

As a convenient reference, I'd like to cite the 1984 Helicopter Annual, copies of which were provided to the staff in advance and additional copies are available over on the table. Instead of going through a bunch of charts and "gee whiz" numbers, the information is basically in the annual in terms of the equipment that we're talking about and in terms of the applications that we're speaking about and in terms of the companies.

Helicopters frequently operate in remote areas around the clock, in all weather, and they can and frequently do operate out of fields not much bigger than the helicopter themselves. Case in point, offshore oil rigs.

As a result of operating in this off airways, frequently low-altitude environment, helicopters often do not have access to the communications, navigation, and surveillance resources of the national airspace system. Helicopters are also becoming more numerous and more important in the metropolitan areas. Here they contribute to the multimodal transportation system, provide efficient air vehicles for all public service activities and serve many other essential roles, all without hinderance from the massive traffic grid locks which are becoming more familiar in all of our cities.

In many instances, the helicopter is the only vehicle which can be relied upon for emergency missions or for other special applications. Today's third-generation helicopters are safe, reliable, and responsive to the heavy demands placed upon them. Helicopters can fly much steeper angles of descent. They can easily land at and take off from a place on an airport other than the runways, and this is an important point.

We strongly advocate more public-use heliports in city centers where helicopters could provide convenient and responsive transportation. We also fully support the ongoing efforts to implement the microwave landing system and to exploit diversatility of area navigation.

In directing our attention to technology issues, HAI envisions that substantive benefits will be derived from increased use of RNAV. Implementation of MLS and accelerated development of programs related to VTOL techniques. These operational techniques must be applied to the lower altitudes and to both airport and heliport flight procedures in terminal areas if we are to achieve the greatest overall benefits to all aviation segments.

Most low-level helicopters are constrained in their ability to use the FAA's VOR/DME line-of-sight systems commonly used for airways and fixed wing area navigation. VOR RNAV is useful, however, for helicopter IFR operations between airports and it's the basis for the experimental Northeast Corridor Helicopter Route System between Washington, DC, New York City, and Boston.

Segments of this corridor were quite successful and are in use today on a limited, nonpublic basis. The RNAV corridor reduces airspace requirements by one-half and uses a 2-mile route width.

VOR RNAV also offers great potential in terminal areas since area navigation would provide for noninterfering IFR and VFR helicopter routes.

Area navigation is not limited to line-of-sight systems such as VOR/DME. Much greater potential is available from other systems such as inertial navigation systems, loran C, Omega/VLF, Decca, and hopefully eventually GPS. MLS has some RNAV potential but it's limited to small pie-shaped segments of airspace.

Currently, the RTCA is developing minimum operating performance standards for MLS–RNAV in its special Committee SC–151. I think other people will be referring to that also.

Loran C and Omega/VLF are relied upon for primary VFR and IFR navigation in the Gulf of Mexico area and other areas where there is such coverage. Loran C is becoming quite popular throughout the entire United States, or most of the United States where there is coverage, and provides an excellent navigational signal for low-altitude operations and that's our special helicopter requirement.

Many corporate helicopters routinely operate IFR into the Washington, DC, area and then proceed via special helicopter VFR routes to expedite their arrival at National Airport. We think these routes should become public routes and they should be depicted on public charts for greater distribution and use.

Some multisensor RNAV systems include both VOR and Loran C area navigation capabilities. These permit point-to-point flights using VOR and enable continued flight with Loran C below VOR coverage with economic gains in fuel savings and lower cost of operations.

Considering the number of civil helicopters in operation today, even small percentages of time saved can amount to major gains in fuel conservation over a 1-year period. In offshore areas, such as the gulf coast, where most navigation is based on the magnetic compass and dead reckoning, these systems pay for themselves quickly.

Many helicopters there in the gulf do not even bother to install VOR receivers since VOR is of very little use at the low altitudes they fly and distances out to sea. Low-level area navigation is absolutely vital to continued growth of the helicopter and its applications. This is projected to at least double, if not triple, by the year 2000.

It's necessary in the development of the IFR systems, and we'd like to see greater integration of Loran C or GPS systems into the national airspace system.

Benefits of RNAV are highlighted and recognized in the National Airspace Review. The NAR has approved dozens of RNAV recommendations and we urge rapid implementation of the enhancement, such as the use of Loran as imput to the existing IBM 9020 computer used in the automated ARTCC. Data transfer from the helicopter's onboard Loran receiver is currently being fed through the communications radios with filters to the experimental Loran flight following system [LOFF] at Houston Center.

One of the two commercial operators down there also use LOFF for readout of real time helicopter positions on a cathode ray tube. The same data could easily be fed into the 9020 computer for use on controller plan view displays as a substitute for radar data which is not available because of altitudes and ranges.

Such systems enhancements would be quantum steps forward in terms of efficiency and safety.

Area navigation makes it possible to proceed direct to a destination or to a point from which to commence an approach, either VFR or IFR. In the gulf coast today, the IFR helicopter can also proceed to HEDA's. This is helicopter en route descent areas, and these were an innovative solution for flying IFR and then descending to VFR conditions in large open areas where there are no approaches.

Weather radar is also used in conjunction with area navigation to make instrument approaches to offshore production and drilling platforms. These are called ARA radar approaches.

Area navigation and the associated landing technologies do offer unlimited potential and much can be accomplished if we take full advantage of these present and future systems capabilities.

With respect to VTO or near VTO, helicopters and rotorcraft have unique characteristics that are difficult to fully understand and apply to VFR/IFR landing criteria and standards. I would like to point out for those who aren't really familiar with helicopters that a helicopter is able to stop and then land; where a fixed-wing aircraft, of course, has to do it the other way. It has to land and then stop. That's an important difference to bear in mind when we're speaking of integrating these into the same air system.

Although helicopters have been flying IFR for over 30 years, there's not one single public helicopter instrument procedure available to use in this country today. In order to descend toward the ground at a reasonable descent rate and to avoid inadvertent flight into the surface, air speed must be reduced as the steepness of the glide slope angle increases to clear obstructions. Typically, a helicopter makes an IFR approach at an air speed between 60 and 120 knots. Since the air speed can be varied in a helicopter for a given situation, helicopter pilots apply a variety of techniques.

If obstacles are not a problem, deceleration may be achieved during the final approach on a shallow glide slope such as the standard three-degree, fixed-wing ILS glide slope. The shallow glide slope also enables the helicopter to fly at higher speeds to minimize air traffic delays to other aircraft.

In fact, many helicopters can fly faster than some turbojets in landing configuration and this is important because it keeps from impeding the flow of traffic.

Mr. GLICKMAN. Mr. Jensen, could we ask you to summarize in a couple of minutes——

Mr. JENSEN. Sure.

Mr. GLICKMAN. We've got a bunch of witnesses and I don't want to—we may have some votes after 12, that's our problem.

Mr. JENSEN. Well, I'll skip back to page 12. Overall, in comparing ILS to MLS, we believe that far greater potential is available with MLS and we look forward to its use in future city center commuter links in city center-to-airport operations.

To maximize benefits from current and future landing technologies, we need continued research, and perhaps even more importantly, we need more effort directed toward airspace planning, procedural development and chart design to achieve the greatest potential.

I've not addressed wind shear systems. We think they will also help helicopters.

In summary, this testimony reflects the civil helicopter operator's views concerning the development of aircraft navigation and landing systems that are well within the reach of current and future technology. Unlimited opportunities exist, but resources and dedicated knowledgeable people are needed to bring these recommendations to fruition.

The helicopter industry is maturing in all-weather capability and in recent years has been the fastest-growing segment in aviation. We operate throughout the country, regardless of availability of runways or landing aids, providing transportation services and lifesaving benefits to the general public, the business community, the government and the individual

The helicopter operator is vital and versatile and we look forward to the future.

Thank you, Mr. Chairman, for this opportunity.

[The prepared statement of Mr. Jensen follows:]

Statement by

Frank L. Jensen, Jr., Executive Director

Helicopter Association International

Before the

House Science and Technology Subcommittee

United States House of Representatives

July 24, 1984

Mr. Chairman and members of the Sub-Committee:

I am pleased to be here today to comment on behalf of the commercial helicopter industry regarding the operational aspects of Area Navigation Systems, and Microwave Landing Systems. I am accompanied by HAI's Director of Operations, Louis P. Bartolotta, Jr.

The Helicopter Association International is an independent, non-profit organization, formed in 1948. Our regular members are civil companies and organizations which operate helicopters. Our associate members are the manufacturers of helicopters, engines, components and ancillary equipment, as well as suppliers, brokers, insurers and service organizations. About eighty percent of HAI's membership is from the United States, and the remainder are from forty nations around the world. There are also affiliate members, primarily regional helicopter associations, and sustaining members, for a total of nearly 1,100 members. HAI provides a

unique and valuable forum for the entire civil helicopter industry.

HAI's regular members operate helicopters in the fields of agriculture, air carrier, air taxi, construction, corporate transport, electronic news gathering, executive transport, exploration, fire control, forestry, and law enforcement, among many other important uses. The helicopters operated by HAI's regular members range from small two-place machines powered by a single 200-horsepower reciprocating engine, to the free world's largest commercial helicopter which carries 44 passengers and a crew of three, and has two turbine engines, each with more than 4,000 horsepower. In all, there are more than 9,000 civil helicopters in operation within the U.S. at this time.

As a convenient reference I would like to cite the 1984 Helicopter Annual, which is a 272-page, four-color industry overview published by HAI. Copies were provided in advance to the staff, and additional copies are available on the tables.

Helicopters are important, versatile, and fairly ubiquitous users of the nation's airspace. More important to this particular hearing, helicopters frequently operate in remote areas, around the clock, in all weather, and they can and frequently do operate out of fields not much bigger than the machines themselves. Case in point: Offshore Oil Rigs.

As a result of operating in this off-airways, frequently low-altitude environment, helicopters often do not have access to the communications,

navigation and surveillance resources of the National Airspace System.

Helicopter operators often must build their own heliports, provide their own navigational aids, and frequently use road maps rather than aeronautical charts, as a matter of practical necessity. Helicopter operators also must often operate their own flight-planning, flight following, and weather facilities.

However, helicopters are also becoming more numerous and more important in the metropolitan areas. Here, they contribute to the multi-modal transportation system, provide efficient air vehicles for all public service activities, and serve many other essential roles ... all without hindrance from the massive traffic grid-locks which are becoming more familiar in all of our cities. In many instances, the helicopter is the only vehicle which can be relied upon for emergency missions or other special applications.

Today's third-generation helicopters are safe, reliable, and responsive to the heavy demands placed upon them. They will be even more so when all air traffic controllers recognize their unique capabilities and use these to the mutual advantage of the air traffic control system and its users. Helicopters do not need to be integrated into the landing system between 747s in trail. Helicopters can fly much steeper angles of descent, can easily land at and take off from places on the airport other than the runways.

We would strongly advocate more public-use heliports in city centers, where helicopters could provide convenient and responsive transportation. We also fully support the on-going efforts to implement the Microwave Landing System and to exploit the versatility of area navigation.

During the last two years, the Federal Aviation Administration has made significant progress in several major program areas. The National Airspace System Plan (NASP) has refocussed the direction and importance of national aviation planning and program management.

The National Airspace Review (NAR) has been one of the most comprehensive federal efforts we have seen to integrate public and user views into a much needed overhaul of the complex Airspace and Air Traffic procedures and operating systems. The products of this review will become the foundation for the transition into future ATC systems.

The FAA Rotorcraft Program Office, a long overdue need, has also accomplished a major achievement in the completion of a Rotorcraft Master Plan that ties together and helps coordinate developmental, operational, air traffic, certification and airports programs. This program office, like the airspace review, has worked closely with helicopter operators and industry to acquire an understanding of unique helicopter problems and needs.

In directing our attention to technology issues, the Helicopter Association

envisions that substantive benefits will be derived from increased use of Area Navigation (RNAV), implementation of Microwave Landing Systems (MLS) and accelerated development of programs related to Vertical (or Near-Vertical) Take Off and Landing (VTOL) techniques. These efforts must be applied to the lower altitudes and to both airport and heliport flight procedures in terminal areas if we are to achieve the greatest overall benefits to all aviation segments.

First let me discuss Area Navigation from the helicopter operator's viewpoint as we know it today. Most low level helicopters are constrained in their ability to use the FAA's VOR-DME line-of-sight system commonly used for airways and fixed wing area navigation. VOR RNAV is useful, however, for helicopter IFR operations between airports and it is the basis for the experimental Northeast Corridor Helicopter Route System between Washington, D.C., New York City and Boston. Segments of the Northeast Corridor were quite successful and are in use today on a limited, non-public basis. The RNAV Corridor reduces airspace requirements by one half and uses a two-mile route width. The narrow width created administrative and certification problems, and we would gladly accept standard RNAV route width criteria to open up these and other helicopter corridors to the public.

VOR RNAV also offers great potential in terminal areas since area navigation would provide for non-interfering IFR and VFR helicopter routes. These could be referred to as Helicopter Visual Routes or Helicopter

Instrument Routes (HVR's/HIR's) on VFR and IFR charts to differentiate those segments intended for helicopter use, either en route or as arrival/departure routes at heliports and airports. Such routes, when carefully pre-planned and coordinated to avoid conventional flows, reduce controller workload and will help increase runway capacities. ATC separation is reduced since runways can still be used for taxiing, while the helicopters complete their approach and maneuver to heliports. VOR RNAV systems are limited, of course, to non-precision approach minima and VOR coverage.

Area navigation is not limited to line-of-sight VOR-DME systems, and much greater potential is available from other systems such as inertial navigation systems (INS), LORAN C, Omega/VLF, Decca, and hopefully GPS. MLS has some potential but is limited to small pie shaped segments of airspace. Currently the Radio Technical Commission for Aeronautics (RTCA) is developing minimum operating performance standards for MLS-RNAV in its Special Committee SC-151. Of these systems, LORAN C and Omega/VLF are relied upon for primary VFR and IFR navigation in the Gulf Coast and other areas where there is coverage. LORAN C is becoming quite popular throughout the U.S. and provides an excellent navigational signal for low altitude operations. It is believed that two additional LORAN stations could provide full U.S. coverage. There is also great potential for LORAN C type systems to be used for approach procedures as well as for en route operations. RNAV-equipped helicopters routinely program their equipment to supplement their VFR and IFR oprations by adding LORAN coordinates to VFR and IFR charts to enhance their ability to fly direct to destinations to

save time and fuel.

Also, many corporate helicopters routinely operate IFR into the Washington D.C. area and then proceed via special helicopter VFR routes to expedite their arrival at National. Incidentally, we think that these routes should become public routes, and they should be depicted on public charts for greater distribution and use.

Some multi-sensor RNAV systems include both VOR and LORAN C area navigation capabilities. These permit point-to-point flights using VOR and enable continued flight with LORAN C below VOR coverage with economic gains in fuel savings and lower cost of operations.

Considering some 9,000 or more civil helicopters in operation today, even small percentages can amount to major gains in fuel conservation over a one year period. In offshore areas such as the Gulf Coast where most navigation is based on the magnetic compass and dead reckoning, these systems pay for themselves quickly. Many helicopters there do not even bother to install VOR receivers since VOR is of very little use unless it is required for IFR certification.

Low level area navigation is absolutely vital to continued growth of the helicopter, which is projected to at least double, if not triple by the year 2000. It is necessary in the development of IFR systems, and we would like to see greater integration of LORAN C or GPS systems in the national

airspace system.

Benefits of area navigation are highlighted and recognized in the National Airspace Review. The NAR has approved dozens of RNAV recommendations, and we urge rapid implementation of the enhancements, such as the use of LORAN as input to the existing IBM 9020 computer used in the automated Air Route Traffic Control Centers. Data transfer from the helicopter's on board LORAN receiver is currently being fed through communications radios (with filters) to the experimental LORAN Flight Following System (LOFF) at Houston Center. One or two commercial operators also use LOFF for readout of real time helicopter position on a CRT. The same data could easily be fed into the 9020 computer for use on controller plan view displays (PVD's) as a substitute for radar data. Such systems enhancements would be quantum steps forward in terms of efficiency and safety. The digitized signal is a form of verification that the pilot is where he says he is. This verification is similar to an aircraft transponder Mode C altitude readout, based on 29.92, that is sent to the 9020 through the ATCRBS beacon interrogator. (The 9020 converts this to altimeter setting below FL 180 so that altitude readout for the controller is the same as what the pilot would be viewing on his altimeter.)

Area navigation makes it possible to proceed direct to a destination or to a point from which to commence an approach either VFR or IFR. In the Gulf Coast today, the IFR helicopter can also proceed to HEDA's. HEDA's are Helicopter En Route Descent Areas, which were an innovative solution for flying IFR and descending to VFR conditions in large areas where there are

no approaches. Since overwater flight has less risk from terrain or obstructions, this was a sensible alternative to scud-running through coastal fog. Weather radar is also used in conjunction with area navigation to make instrument approaches to offshore production and drilling platforms. Additional minimum safe altitude data in ATC facilities and on VFR/IFR charts makes this an overland possibility today throughout the U.S.

As you can see, area navigation and the associated landing technologies do offer unlimited potential, and much can be accomplished if we take full advantage of these present and future systems capabilities.

With respect to Vertical Take Off and Landing, or near-vertical take off and landing, helicopters and rotorcraft have unique characteristics that are difficult to fully understand and apply to VFR/IFR landing criteria and standards. To use a simile, I like to point out that helicopter can stop and then land, while a fixed wing airplane must land, and then stop. Although helicopters have been flying IFR for over thirty years, there is not one single public helicopter instrument approach procedure available to use in this country. One of the problems is the definition of acceptable approach angles and protected airspace for safe instrument letdown. Another may well be that we just don't yell loud enough, or that we're so flexible it is easier to fly the fixed wing patterns.

In order to descend toward the ground at reasonable descent rates and avoid

inadvertent flight into the surface, airspeed must be reduced as the steepness of the glide slope angle increases to clear obstructions. Typically, a helicopter makes an IFR approach at an airspeed between 60 and 120 knots. Since airspeed can be varied for a given situation, helicopter pilots apply a variety of techniques. If obstacles are not a problem, deceleration may be achieved during the final approach on a shallow glide slope such as the standard three degree fixed wing ILS glide slope. The shallow glide slope also enables the helicopter to fly at higher speeds to minimize Air Traffic delays to other aircraft. In fact, many helicopters can fly faster than some turbojets in landing configuration, and higher helicopter speed can be used to the system's advantage, especially in busy terminal areas.

Conversely, when obstructions require steeper glide slope angles, approach speeds will be slower. (Currently most civil helicopters operate IFR above 60 knots, although some helicopters have been and are being certified at lower speeds. One problem is that fixed wing pitot and airspeed systems indicators are not too reliable on helicopters flying slower than 40 knots, especially in instrument conditions or in turbulence.)

To optimize the benefits of helicopter instrument routes at airports and heliports, helicopter approaches will often require glide slopes with variable angles to accommodate approaches from different directions or approaches with both high and low speeds. Microwave Landing Systems offer this potential, and we envision that MLS at airports will be sited in such a manner that coverage would provide for both rotorcraft and simultaneous

fixed wing approaches. Converging approaches will be practical, and we believe the helicopters' slow speed and maneuvering capability will enhance controller confidence and safety. Closure rates could be easily controlled using either radar or pre-planned non-radar separation criteria. At many large airports, airplane instrument approach procedures terminate about a half mile to one mile from the runway. The distance from that point to the terminal area, other approach termination points, or to heliports can often be one, two or three miles; therefore, greater advantage can be taken of MLS and RNAV systems than most people realize, and still meet necessary vertical/horizontal requirements until pilots or controllers acquire visual separation.

The Helicopter Association supports Microwave Landing System implementation at airports, provided the cost is reasonable. We would expect that the cost of avionics is reasonable and that MLS transition would allow routine equippage and replacement as ILS systems wear out.

For heliports with low density traffic, MLS will be difficult to justify. No doubt the MLS cost would have to be low, and it would be compared to non-precision capabilities of LORAN C and GPS. Overall, remote area use of MLS will be minimal, with a few exceptions.

It is vitally important that the FAA install MLS at the prototype all-weather demonstration heliports in New York City, Los Angeles, Indianapolis, and New Orleans to study the characteristics of MLS siting

and develop acceptable helicopter approach techniques in urban areas. At this point it is not clear that the low cost community version of MLS will serve the need at all prototype heliports. The full system with missed approach guidance and wide coverage may best accommodate the helicopter's ability to fly curved RNAV and decelerating approaches.

Overall, in comparing ILS to MLS, we believe far greater potential is available with MLS, and we look forward to its use in future city center commuter links and city center-airport operations.

To maximize benefits from current and future landing technologies, we need continued research; and perhaps even more importantly, we need more effort directed toward airspace planning, procedural development, and chart design to achieve possible benefits. Large efforts have gone into fixed wing traffic flow management systems, tabulation of IFR aircraft delays, revision of center sectors, and the New York metroplex arrival/departure systems, but there is no way of determining the extent of helicopter delays in remote areas because of lack of system access, nor is there any way to measure wasted fuel or the delays experienced by users providing VFR transportation. There have been significant efforts at a few facilities around the country to develop helicopter routes, but there are few real operational initiatives underway to achieve our needs in the foreseeable future. We would very much like to see landing technology, and public helicopter routes, procedures and charts become a reality.

I have not addressed wind shear systems, although helicopters may benefit

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somewhat from airport runway systems. Systems that reach out beyond airport traffic areas and to mountainous areas surrounding airports might be of greater value since terrain or large man-made objects (e.g., tall buildings in cities) are likely to affect helicopter operations.

In summary, this testimony reflects the civil helicopter operator's views concerning the development of aircraft navigation and landing systems that are well within the reach of current and future technology. Unlimited opportunities exist, but resources and dedicated, knowledgeable people are needed to bring these recommendations to fruition.

The helicopter industry is maturing in all-weather capability, and in recent years has been the fastest growing segment in aviation. We operate throughout the country, regardless of availability of landing aids, providing transportation services and life saving benefits to the general public, the business community, the government, and the individual.

The helicopter operator is vital--and versatile--and we look forward to the future.

Thank you for this opportunity to make our views known.

Mr. GLICKMAN. Thank you.

Mr. Warner, with AOPA. Pleasure to have you here.

Mr. WARNER. Thank you very much, Mr. Chairman, and members of the committee. I don't believe we need introduce AOPA nor general aviation to this committee. We have been in this seat many times before. However, I do feel that we're in somewhat of a unique position today, amongst this panel of witnesses, in that we are the only organization representing constituents that have already invested considerable money on their own for airborne equipment to comply with the system that we have in place today and, therefore, I think we bring a slightly different perspective than most of the others at the table.

I would, however, like to focus in introducing our concerns about MLS, RNAV and STOL techniques by defining general aviation in a slightly different light than usual. As you know, we own and operate 95 percent of the civil aircraft in the United States. What you may not know, however, and is particularly appropriate to the discussion of precision approach landing equipment, is that there are 202,000 general aviation aircraft in the country, and 143,000 of those 202,000 have already made the investment and have ILS equipment on their instrument panel.

We also bring a couple of other different focuses to the discussions today. First, AOPA is concerned about a dying general aviation industry. We're concerned about an industry that has an average price of a new aircraft in the last 5 years that's gone from $100,000 to $675,000. We're concerned about the mentality that the only flying that's necessary is business flying. We're concerned that people have forgotten about personal transportation that can be provided by general aviation aircraft, and we've forgotten that we need to regenerate—that is, concern ourselves with students starts and new pilots and new aircraft owners being brought into the community. That's akin to the last point, of course, that we seem to be ignoring the cost factor in many of the deliberations that are taking place.

We are most interested in the subject of these hearings and we're interested in any hearings or discussions that deal with the increased utility of the general aviation aircraft and/or the reduction in any economic sense of the use of that aircraft. I'll not comment on the subjects of RNAV and STOL techniques. I've been here for the morning and I've read the testimony of the other witnesses that will follow. AOPA generally agrees with the comments of everyone on the subjects of the utility of area navigation equipment, area navigation aids and procedures that must be put into place by the Federal Government.

But I would like to spend a limited amount of time discussing MLS because I think that's where we might be at odds with some of the other witnesses, primarily because we are consumers of aviation products and goods. As we look at the question of microwave landing systems and changing the standard for the precision approach aid in 1983 and 1984, we ask ourselves a simple "why?" Who needs it? Why would we want it? What does it buy us? Can we afford it? Does it make sense at this time? Are the locations that the FAA proposes for MLS the logical ones? Is it safer?

And unfortunately, the only affirmative answer we come to through that list of questions is where there's a site-difficult location, where ILS—the time tried and true precision approach landing system is impossible, we would agree that microwave landing systems have that special application and should be put into place.

Many of the earlier witnesses talked of those special applications on spur runways at major metropolitan airports and at remote locations that are literally impossible to play on ILS. We would take nothing away from that need, and indeed, AOPA has concurred with that all along.

Let me answer some of those questions for you very quickly. Who needs it? The FAA says that the commuter airlines need it, the helicopter people need it, and business jet operators have indicated that they need it.

Why would we want it? We would want it if it provided us with something better than ILS. And except in special cases, it does not.

What does it buy us? It buys us more precision of a specific signal—again, as was pointed out earlier—more precision than we need. Two hundred and a half is close enough to the ground in most cases.

Can we afford it? As I mentioned earlier, we simply cannot afford it.

Does it make sense at this time? No.

Are the proposed locations the right ones? Definitely not and we'll speak to some of those in a moment.

Is it safer? No. Most general aviation pilots and aircraft owners do not want microwave landing systems. Indeed, 2 weeks ago, a delegation of pilot groups from 29 nations around the world spoke in the same, united voice when they unilaterally voted for an extension of the ILS protection date to be within the ICAO standards.

Lest we be called one, I don't want you to have the perception that AOPA is taking a Neanderthal, no-progress approach. That's far from the case and a look at the instrument panels of many of the newer general aviation aircraft and many of the older ones that have been retrofitted would indicate that we are not a no-progress segment of the aviation community.

But we have evaluated the transition plan; we've considered the cost of the ground equipment and the airborne equipment; and we've looked at the alternatives. And I would like to quickly go through those discussions, realizing that they're all secondary to the point that we simply—when you consider the cost and what it will provide, don't believe MLS is necessary at this time except in special applications.

Airborne cost. We are searching the horizon for the $2,500 to $3,000 low-cost general aviation MLS receiver that we were told would be available as much as 4 years ago. We have contacted every avionics manufacturer asking them when it will be on the market and the answer is that when there's a market, it will be there. They don't know what the price will be. Remember, $2,500 to $3,000 amount was in 1980 dollars.

What we do hear from the manufacturers are the press releases of the current equipment that is available for general aviation—now priced between $11,000 and $13,000 for a straight-in approach,

the same capability that can be provided by ILS today, and one that we've already invested in.

It's not that we're cheap. The fact is that we've already bought the equipment to have communications and navigation including precision landing equipment, and in some cases, redundant communication and navigation equipment in the airplane. Minimum-priced state of the art equipment, for this would cost about $8,000. We're faced with being asked to put in a single piece of equipment for the last 5 miles of a landing approach at some 1,200 runways of more than 12,000 airports that costs more than our entire existing investment in radio equipment.

If you want the fancy stuff, the segmented approach, the curved approaches, the steep approaches, the routes around noise-sensitive areas, it's all extra money. It's all on top of the $13,000 that it would cost today to go buy an MLS receiver. Many single-engine general aviation aircraft that are equipped for IFR flight don't value that much for the whole airplane today.

You also need additional pilot qualifications and precision approach DME for some of the lower landing minima that's being discussed as being one of the advantages of MLS, and no one yet has spoken to the question of who will pay the costs of installing this equipment in the aircraft and the fact that there will be supplemental type certificates needed on each individual aircraft.

The ground costs. If you have some idle time, I would suggest that you might want to try to find out how much it costs to install an MLS ground unit in comparison with an ILS. Every time we pick up the phone and ask the question, we get a different answer.

Obviously, it's a very competitive market right now with everyone positioning themselves to try to have the MLS market for the United States and the world. The leading manufacturer of ILS equipment tells us that ILS costs $350,000 to install as of last week. What we know from our research in the last 2 weeks is that the Valdez MLS costs $800,000 to install; the Cadillac, MI, MLS, which is still not approved for public use, costs $315,000 to install and it does not have precision DME.

The recent contract that was let with Hazeltine for the first buy of MLS's indicates that they are about $500,000. There is no cost savings up front between that and ILS.

Maintenance. Maintenance is more for ILS, we would admit, because they are remote monitoring features of the MLS that make it more advantageous. Has anyone asked the question of whether we can put remote maintenance monitoring on solid state ILS, which we're already equipped to fly?

Who says they want MLS and why do they say that?

The FAA indicates that it will increase airport capacity. Earlier witnesses have indicated that more concrete will go much further distance to increasing airport capacity. I would like to mention a couple of the locations that have been denied ILS and will now be receiving MLS. Obviously these are places that will need MLS to increase airport capacity. One of them is Chadron, NE. Another is Cedar City, UT. I would suggest that it will be quite a while before we have an airport capacity problem at Cedar City, UT.

The FAA wants it for lower ground system costs. I've already discussed that aspect.

How about the airspace efficiency argument? The use of MLS will provide us with curved approach paths and segmented approach paths so that we will be able to drop more airplanes into airports that are closely positioned to one another. Why, then, do we have such locations as London, Kentucky, and Ely, NV, on the list to receive MLS? These locations have an airspace congestion problem?

The real reasons behind FAA's, determination that MLS is the system of the future, are, that it was a good idea in the 1970's, FAA had a long-fought battle in the international arena, and MLS fits very tidily into the national airspace system plan.

I'll abbreviate my comments and move on to say that we must consider the discussions about how much safer MLS is. Every instrument approach aid in this country is equally safe if we do not fly outside the legal parameters of the signal that's provided, period. There is no safety discussion about MLS. There's only an economic discussion.

Commuter airlines and, indeed, general aviation, who are flying some of the same short routes, would find it advantageous to be able to land in certain poor weather conditions and any precision approach aid that would decrease the minimums, would add to the utility of an airport. This would improve the economic situation of whoever is making that approach, whether it's the air carrier, general aviation, air taxi, commuter, or helicopter. It makes no difference. But the question is, is it worth the money to the majority of general aviation. The answer is no.

Yes, MLS can provide 200½, as can ILS. We think that is adequate. The availability of approaches to a 200-foot ceiling and a half a mile visibility means something different in foggy Boston than it does in sunny Key West, FL. You rarely need to descend to 200 feet in Key West, FL.

And finally, I'd like to point to the arbitrary transition plan that the FAA has entered into and the fact that this decision has denied precision approach capability to those communities for 257 years. Those are the total number of years between when the ILS was scheduled to be implemented at nearly 100 airports and when MLS is now scheduled to be installed, bar any delays.

Mr. Chairman, in Kansas, I might point out, there are four such locations. One of them has met ILS criteria for a number of years. Dodge City was scheduled for ILS installation in September 1982. It's now scheduled, bar any delays in MLS implementation, to have a precision approach aid in 1991. We question whether there's airport capacity problems or will be in 1991 at Dodge City.

ILS is more than adequate. We should consider the alternatives, many of which are being discussed at this very moment and should be in place within the next 5 years, both in the public and private sector, and there's no need to go forward with MLS implementation except in the cases of special site-specific, terrain-difficult locations.

Thank you very much for the opportunity to comment.

[The prepared statement of Mr. Warner follows:]

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STATEMENT OF ROBERT T. WARNER

SENIOR VICE PRESIDENT, GOVERNMENT AND PUBLIC AFFAIRS

AIRCRAFT OWNERS AND PILOTS ASSOCIATION

REGARDING AREA NAVIGATION, STOL TECHNIQUES AND MICROWAVE LANDING SYSTEMS

COMMITTEE ON SCIENCE AND TECHNOLOGY

SUBCOMMITTEE ON TRANSPORTATION, AVIATION AND MATERIALS

HONORABLE DAN GLICKMAN, CHAIRMAN

U.S. HOUSE OF REPRESENTATIVES

TUESDAY, July 24, 1984

I am Robert Warner, Senior Vice President, Government and Public Affairs for the Aircraft Owners and Pilots Association (AOPA). I appreciate the opportunity to appear before the Subcommittee on Transportation, Aviation and Materials to express AOPA's views on the subjects of aircraft navigation and landing techniques.

AOPA represents the aviation interests of more than 265,000 aircraft owners and pilots who have authorized us to speak in their behalf. As a true cross section of the aviation community, general aviation uses and has future requirements for the full range of navigation and landing services available in the national airspace system.

The oversight responsibility of this Subcommittee, and specifically the subject of this hearing is of considerable interest to AOPA and its membership. Of course, the aircraft owner subset of our membership is uniquely interested in increasing the utility of their investment and in any developments which may unduly and unnecessarily increase the cost of ownership.

Having philosophically disagreed with the "aviation has no public benefit" decisions of 1982, AOPA has promised its membership to review carefully each element of the National Aviation System Plan and other user-funded programs.

Safety and traffic congestion in the terminal area are topics that are of prime importance to us. To fully realize the utility value of general aviation aircraft, we must negotiate this segment of the trip as quickly as possible. Delays and complicated procedures both reduce the utility of general aviation aircraft and impose heavy workloads on pilots. Either or both of these are unsatisfactory by-products of a system that should serve the user.

Area Navigation

While we heartily endorse the concept of Area Navigation (RNAV), unfortunately it has not realized its full potential. Only about one-seventh of all general aviation aircraft are RNAV equipped, so there is a perception among general aviation interests that assigns a relatively lower value to this device. However, the equipage rate is increasing.

Specific airports may benefit from RNAV approaches, but radar vectoring often offsets potential advantages. Perhaps the greatest beneficiary of RNAV routes and approaches are commuter air carriers. The direct route distance savings as a percent of total trip length can be considerable because of the relatively short stage lengths. This same factor often applies to general aviation, also.

We encourage the FAA to continue to refine RNAV procedures and features in the terminal area. Much time and effort can be saved if RNAV is used efficiently. This coupled with more competitive airborne equipment prices should bring the RNAV concept to maturity.

Any other procedural refinements in the terminal area would be most welcome, too. Circuitous routings, whether RNAV is used or not, cause expensive delays in terms of utility value and fuel costs. Efforts must continue to streamline and simplify procedures in terminal areas if the true potential of the airplane is to be realized.

STOL Airport Technology

AOPA has advocated the enhancement of airport capability by the addition of short parallel runways at major airports and the establishment of adequate general aviation service facilities and instrument approaches. However, AOPA has always recommended something more than 1500-2000 foot long "STOL runways." Only specially designed and configured STOL aircraft or smaller

single-engine aircraft are able to safely use these strips. Instead, we recommend runways of between 3000 feet and 4000 feet in length because they are able to safely accommodate the majority of the general aviation fleet, including small jets.

Construction of short parallel runways expedite overall flow of traffic and permit general aviation aircraft to avoid dangerous wake turbulence created by heavier aircraft. Examples of useful efforts in this direction exist at Baltimore-Washington International which has a new general aviation runway 15L/33R (3199' x 75') in place, and the Dulles International experiment with marking long taxiways for use as short runways. AOPA strongly believes that further emphasis on such initiatives could provide:

- reduced occupancy times on primary runways,

- reduced spacing between parallel runways for VFR use, and

- independent instrument approaches to the new short runways.

Further, to achieve maximized utility of the airspace, AOPA encourages early funding and completion of wake turbulence studies recommended by the National Airspace Review. We believe that substantial reductions in separation criteria may be possible based on accurate knowledge of wake turbulence.

Precision Approach Landing Aids (ILS/MLS)

On the subject of precision approach landing aids, FAA has misled Congress and the flying public. In the last two years, FAA has carefully orchestrated an effort to change the standards of precision approach aids from the time-tested Instrument Landing System (ILS) to the much-touted Microwave Landing System (MLS). The facts are that the FAA appears to have an "invented-here-interest" in defending the time-referenced scanning beam MLS because of years of hard fought battles in the international arena.

This attitude is more pronounced in light of the United Kingdom's recent purchase of still more ILSs and the authoritative paper presented in ICAO deliberations two weeks ago which claimed that "not a single operator of aircraft in Europe is calling for MLS."

The FAA has done an atrocious job of designing the transition plan. AOPA analysis of the current plan indicates an "opportunity cost" of 257 years. That is, 257 years during which precision approach capability will be delayed at numerous airports, denying those communities the improved service that could have been provided prior to FAA's abrupt and arbitrary cutoff of planned ILS installations. There is no reasonable way to project the economic impact of this loss, but we believe it to be substantial.

There have been numerous claims made as to the "aviation community acceptance" of the MLS and the FAA's transition plans. Many aviation organizations have aligned themselves with the FAA program only because it is a part of the NAS Plan. However, AOPA, which represents the largest number of airport users and consumers of aviation goods and products as well as owners of 143,000 aircraft who have ILS receivers installed (112,000 with full systems, many with 2 systems), has considerable concern with the MLS program.

AOPA's concern can be summed up in one question: "Where is the need?" Ours is not a Neanderthal, no-progress position. We acknowledge our past support of MLS development. However, the promises of precision approach aids where it was formerly impossible, the promise of low-cost airborne receivers, and the rapidly advancing technology of ILS improvements and potential future navigation systems have passed MLS justification by. Our comments are not without substantiation and the positive claims of FAA and others deserve a careful review including the motivation of those claims.

Let's examine some of the claims and the facts: The FAA has yet to explain to anyone how the MLS will provide for increased safety. There is nothing unsafe about the current approach facilities. Only when flight takes place outside the legal parameters of the current signal coverage of the approach aid is safety diminished. While it has been suggested that MLS will improve safety, such claims are merely economic desires cloaked in safety garb. Improved landing aids create a higher probability of trip completion, when cloud bases and visibility conditions are lower--nothing more.

FAA continues to claim that an increase in airport capacity will result from MLS. Landing aids do not increase airport capacity--more runways, taxiways and ramps do. They claim increased ATC flexibility. This may be true in major metropolitan areas where curved approaches could be designed to eliminate current interfering approach paths at adjacent airports. However, this advantage will apply at very few of the 1250 locations proposed by the FAA.

FAA claims reduced community noise. This is a fantasy-land solution that may be applicable in a handful of locations and only if aircraft are equipped with advanced MLS receivers including precision distance measuring equipment (P/DME) and on-board area navigation computers to fly such approaches. Such equipment will be far beyond the reach of typical general aviation aircraft owners, business or personal. AOPA has yet to hear a single pilot group representing that they will accept a curved approach.

FAA claims a reduction in ATC delays. Again, this would only be applicable where curved approach MLS procedures were established in areas of conflicting airport airspace and, if the majority of the fleet using those airports during IFR conditions were equipped with advanced ($50,000 to $100,000 per installation) MLS.

The FAA's "hub-and-spoke" concept of MLS implementation is based upon service by commuter and regional airlines. This segment of the air transportation industry has been the most frequently stated proponent of MLS. Again, improved safety is claimed when, in fact, economy and financial well-being is the motivation. But, let's consider the foundation on which we are building such an implementation scheme. While many commuters have long histories and financially strong futures, the record shows that 6 out of 10 commuters have gone out of business in the last 10 years. From March 1983 to March 1984, CAB states that 20 locations have lost scheduled air service. By the time an MLS is installed on the basis of scheduled service, will the service still be there? Frankly, we do not understand why the commuters are not asking for ILS ground facilities, since they have already invested in the airborne equipment. With improved ILS antenna technology, many locations that were "ILS installation prohibitive" years ago can now be served with this system.

Business jet operators have claimed an interest in MLS for its alleged airport capacity improvements in the major metropolitan areas where current landing approaches of adjacent airports interfere with one another. With promises of curved approaches and other fancy gadgetry, MLS advocates believe that these landing patterns can be modified to eliminate the interference. We do not deny this is possible, but question the validity of funding system equipment for a tiny percentage of current users. While some corporate operators may have specific justification for purchasing airborne equipment to assist in the movement of their aircraft in these few metropolitan areas, all aviation tax contributors are footing the bill for the ground portion of this system.

Individual aviation consumers, particularly nonbusiness flyers, will not have much motivation to equip with an additional radio that serves only one function--approach guidance for the last five miles of flight to a handful of runways in the entire country. This "single purpose box" might typically be used only a few times a year. Reequipping the approximately 112,000 general aviation aircraft that currently have full ILS capability will cost between $350 million and $1.5 billion, depending on whether you use FAA claims or the current manufacturer's quotes. This is a hidden tax and financial burden that most aircraft owners/aviation taxpayers cannot afford and should not be forced to bear. General aviation representatives from around the world are unified on the lack of need for MLS. At it's recent tenth World Congress, the International Council of AOPAs, representing pilots from 29 nations, passed a unanimous resolution seeking to extend the ILS protection date ten years through the year 2005.

MLS serves as an example of why AOPA believes it would be best to plan for the future rather than live in the present. The original National Airspace System Plan, published more than two years ago, indicated a funding schedule for the initial purchases of MLS ground based equipment. With the request for the funds for 60 units in the current budget, FAA is now a full three years behind the original funding/procurement/installation schedule. We believe that usable satellite guidance will make FAA's program obsolete prior to its completion.

Summary

AOPA believes that RNAV and adequate length additional short runways at major airports promise both increased operational efficiency and safety in the terminal area. Both programs should be more vigorously pursued so that these beneficial features can be universally enjoyed.

MLS does not hold the same promise as do the first two items. It will deprive the majority of the system users of an existing, wholly adequate and proven safe precision approach system - ILS - while requiring them to purchase expensive single-purpose equipment for their aircraft and help fund ground installation from their taxes.

The disgraceful part of this scenario is that by the mid-1990's, a multi-purpose satellite communications/data/navigation system will be available that has better capability than MLS ever will. We are building and paying for a minimally useful interim system.

Therefore, we recommend that MLS installations be slated only for locations with either siting difficulties or specific airspace problems. Planned ILS installations should continue through the end of the decade.

Greatest emphasis and priority should be placed on satellite systems that will not only solve precision approach requirements but will also provide enroute navigation, data transmission and search-and-rescue functions for all modes of transportation. The technology is available; it only has to be tapped.

These systems can be operational by the early 1990s, long before ILS or VOR protection date expiration.

We urge you to opt for these state-of-the-art systems rather than expensive devices that are limited in scope and capability which also levy an unreasonable financial burden on the taxpayer.

Mr. GLICKMAN. Thank you, Mr. Warner.

Mr. Cooke——

Mr. COOKE. Yes, sir, Mr. Chairman.

Mr. GLICKMAN [continuing]. Appreciate having you here.

Mr. COOKE. Appreciate the opportunity to be here and to present views on behalf of the membership of the National Business Aircraft Association, and I'll try to get right to the point.

Business aviation ranks foremost among the growth elements of the aviation world. Changing patterns in air transportation systems continue to favor the purchase and use of business aircraft. We have suffered now 2 years of buffeting from the recession and—which has blurred into constraints that arose from the air traffic controllers' strike. But the greatest threat to us does not lie in recession, economic conditions, or the marketplace. The zone of danger lies in the enforced imposition of constraints on the capacity of the Nation's airspace and airports, constraints which might derive from unwitting failure to execute bold plans, or worse, from Government design.

I'd like to quote our association president from 2 years ago when he said that

> It would be extremely comfortable, from a governmental point of view, to live with a limited, easily dampened, readily smoothed level of demand. We must not let that happen and must elect the difficult challenge of building the system up so that it meets the unconstrained demand.

We want to brief the committee on our views on two projects today: the MLS and area navigation, and I have brought with me two extremely qualified people to do that: Mr. Myron Collier of Cyclops Corp., and Mr. Gilbert Quinby of Quinby Associates. Both have been involved in association efforts to help improve airspace use. I'd like to give up this chair now to Mr. Collier and he, in turn, then, to Mr. Quinby, for their views.

[The prepared statement of Mr. Cooke follows:]

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COMMITTEE ON SCIENCE AND TECHNOLOGY

SUBCOMMITTEE ON TRANSPORTATION, AVIATION AND MATERIALS

HONORABLE DAN GLICKMAN, CHAIRMAN

JULY 24, 1984

STATEMENT OF THE NATIONAL BUSINESS AIRCRAFT ASSOCIATION

For NBAA:

Robert A. Cooke,
Vice President, Operations
National Business Aircraft
Association

Myron W. Collier
Manager, Flight Operations
Cyclops Corporation

Gilbert F. Quinby
Principal
G.F. Quinby Associates

STATEMENT OF MR. R.A. COOKE

Thank you, Mr. Chairman, for the opportunity to present our views on behalf of the members of the National Business Aircraft Association (NBAA). As you know, NBAA represents business aviation in the United States and consists of over 2800 companies which own and operate more than 5000 aircraft of every size and description. NBAA members use their aircraft to satisfy day-to-day needs for air transportation. As a general rule, the aircraft owned and flown by business people in the United States are chosen to fit the particular needs of each company. Thus you will find airplanes of a category commonly thought to be "airliners" carrying the private identifications of American corporations, as well as other smaller turbojet, turboprop and reciprocating engine airplanes, and ever increasing numbers of versatile rotorcraft.

The aircraft used by businesses are essential to business, and are as much a part of the equipment essential to daily business operations as typewriters and telephones. As a consequence, assured access to the air space and airports is not an issue to be negotiated. The Association, bound to represent the aviation related interests of its member companies, therefore, must pay close attention to Aviation programs of both the administration and the Congress. Developments in recent years have had a "good news, bad news" cast to them. We are extremely encouraged by the National Airspace System Plan (NASP) projects which hold the promise of more efficient use of the Nation's airspace, but extremely discouraged by the seemingly snail-like pace at which those programs are implemented and sometimes totally disheartened by lapses in steadfast support from the Congress, especially the timely appropriation of user derived revenues.

Business aviation ranks foremost among the growth elements of the aviation world. Changing patterns in the air transportation system continue to favor purchase and use of business aircraft. We have suffered two years of buffeting by a recession whose outline blurred into the constraints imposed by the air traffic controllers' strike. But the greatest threat to business aircraft use does not reside in seemingly adverse economic data or marketplace conditions which mirror the temporary state of the economy. The zone of danger lies in the enforced imposition of constraints on the capacity of the nation's airspace and airports system, constraints which might derive from unwitting failure to execute bold plans, or worse, government desire. Quoting our Association President, Mr. John H. Winant, from remarks given over two years ago, "...It would be extremely comfortable, for a governmental viewpoint, to live with a limited, easily dampened, readily smoothed level of demand. We must not let that happen and must elect the more difficult challenge of building the system up so that it meets unconstrained demand..."

We want to brief the committee today on our views of two projects which we consider essential to building the system up to meet the unconstrained demand: area navigation and microwave landing system. With me today are two extremely qualified people, Mr. Myron Collier of Cyclops Corporation and Mr. Gilbert Quinby of G.F. Quinby Associates. Both have been involved in our association's efforts to help improve our airspace use, and I will ask them now to take on their respective subjects. First Mr. Collier on the subject of area navigation...

COMMENTS ON AREA NAVIGATION

BY

M. W. COLLIER

Area navigation (RNAV) has been around for nearly two decades. However, it has only been in recent years that its potential to meet many of the needs and challenges of the expanding navigational arena has become recognized. The acknowledgment of RNAV's unique value has occurred in spite of a lack of forceful initiative on the part of the Federal Aviation Administration.

Emerging on its own merit, perhaps it can be said that RNAV is a system of navigation whose time has come. Nor should it go unnoted that RNAV's increasing acceptance and usefulness have been assisted to no small degree by developing and applied electronic technology. Technology that has dissolved many of RNAV's early operational shortcomings.

Ironicallly, however, the proliferation of RNAV through technology has resulted in diverse types of RNAV systems which have contributed to some degree to misconceptions and lack of a clear understanding of what the term RNAV really encompasses.

As defined in the Airman's Information Manual, Pilot/Controller Glossary:

> Area navigation/RNAV is a method of navigation that permits aircraft operations on any desired course within the coverage of station-referenced navigational signals or within the limits of self-contained system capability. The International (IACO) definition adds, "or a combination of these" which perhaps better describes evolving RNAV systems.

Simply stated, regardless of the nav sensor used or the degree of automation or sophistication employed, an RNAV system allows the pilot to navigate randomly and at will, direct to any point in space without the need and encumbrance of meandering from one navaid to another. Obviously, this can save time, energy and money.

Equally significant, RNAV offers the potential to alleviate en route air traffic congestion by circumventing the traditional and outmoded procedure of routing (bunching) aircraft along a common route of flight while adjacent airspace goes unused. Also, if effectively applied, RNAV can reduce controller workloads. Wasted airspace and human resources are luxuries that simply can no longer be tolerated in our Nation Airspace System.

Included among contemporary RNAV systems are VOR/DME-referenced systems, VLF/Omega, Inertial (INS), Loran-C and hybrid systems combining two or more different RNAV systems in a compound unit. Also, a satellite-based global positioning system (GPS) is currently under development.

The VOR/DME RNAV system is considered a short-range system, while the others are considered to be long-range systems. Because each in its own way has advantages and disadvantages that can directly impact pilot workload, it is essential that the ATC controller have a knowledge of each system's capabilities and limitations. More on this later.

The professional corporate pilot has led the way in the practical application of RNAV concepts and procedures. Because he is often required to operate to "outlying" airports that often are not served by dedicated on-site navaids, he quickly learned that RNAV could provide the navigational

support needed. Additionally, some RNAV systems provided "instrument approach" guidance to airports that otherwise would not be accessible during inclement weather.

A major obstacle the corporate pilot encountered when attempting to use RNAV routings was the "system", the Air Traffic Control System. This somewhat inflexible combination of people and concepts ostensibly found it difficult to accept the fact that a pilot could navigate to some point in space which did not lie on an established airway or was not served by some type of conventional navaid without radar assistance.

The irony of all this was that the ATC controller was increasingly assuming the role of aircraft navigator. Consequently, he often became overloaded and was distracted from his intended function of keeping aircraft separated. Nor was this subtle encroachment resisted by some pilots who were quite willing to acquiesce the responsibility for navigating their aircraft.

The initial difficulty of effectively using RNAV was in spite of the fact that the FAA, after extensive in-depth studies, had endorsed the concept of RNAV. At best, perhaps, one could say that FAA extended only cursory efforts which provided little tangible benefit to the aspirant RNAV pilot.

In part, because of continued pressure from various segments of the aviation community, FAA's RNAV position was reviewed, updated and presented in the form of a policy statement issued in Washington, D.C., on January 7, 1977.

In response to FAA's reaffirmed position the National Business Aircraft Association (NBAA) issued its own RNAV policy statement on January 24, 1977, applauding FAA's position and solicited active membership participation in the development of effective RNAV utilization.

In this document NBAA correctly identified the primary key, in my judgment, to the implementation of RNAV in the ATC system - the air traffic controller. It was noted that the controller had a problem when the flexibility of the system exceeded what he thought was his required span of control. He (the controller) was not convinced that the pilot could accurately identify his position in space. It was postulated that until he (the controller) is disabused from this philosophy, RNAV routing will only be utilized on a limited basis. This assessment has been proven correct.

Additionally, NBAA requested of its membership that those having a working knowledge of RNAV equipment and procedures make a point of taking controllers on familiarization rides and to visit ATC facilities to explain how RNAV can effectively be used. Doing this it was believed would add to the controller's knowledge when FAA established the formal RNAV training program it had proposed.

In an effort to keep the RNAV ball rolling and to assist FAA in their rekindled interest, NBAA formed a dedicated RNAV committee consisting of active RNAV users from among its membership. A two-day meeting was convened at NBAA headquarters in Washington, D.C. on May 12, 1977. Included also were invited attendees from FAA and Aircraft Owners and Pilot Association (AOPA).

This working group identified several areas of immediate concern and formulated recommendations based upon impirical data and first-hand experience in an effort to resolve these deficiencies. The recommendations were forwarded to the FAA with an ongoing offer of assistance to expedite the orderly implementation of RNAV into the existing ATC system.

Because the deficiencies and recommendations identified by the committee in 1977 are still germane and need for their resolve is still paramount, a brief listing follows:

EDUCATION

Originally a major roadblock and currently a major restraint to effective RNAV utilization is the fact that many controllers simply don't know much about RNAV. This is a tragedy. Controllers can and must become learned regarding all navigation systems approved for use in the Nation Airspace System. Familiarization rides would be helpful and are recommended. Most importantly, however, increased emphasis on RNAV operations and its use in the ATC system must be included in FAA Academy prospectus.

Handbooks 7110.65 and 7110.10 should be updated to insure that adequate RNAV guidance is provided to controllers and specialists.

Expanded discussion in the Airman's Information Manual (AIM), Part I, in RNAV flight operations and the proper method of planning and filing RNAV flights should be carried out. Information in the AIM and Controller Handbook (7110.65) should be consistent.

Because the importance of RNAV knowledge on the part of the controller was deemed so important and in view that FAA provided no suitable text,

NBAA in the late 1970s developed a document called "RNAV and The Controller". This work was distributed to all appropriate FAA/ATC facilities and its reproduction and use for in-house RNAV training activities was encouraged. The response was most gratifying and it is humbly believed that this effort made a major contribution to the increased understanding and use of RNAV that have occurred in recent years.

CHARTING

(A) Planning chart. No fully adequate planning chart currently exists that is unique for meeting the demands of planning and developing an RNAV route of flight. This has been a major restraint for the RNAV user and undoubtedly has been a deterrent to greater RNAV utilization. A lack of pilot supplied RNAV waypoint data can also overload the controller and may result in the controller denying RNAV routing requests.

Although hand-held electronic calculators show promise in this area, a need exists for an RNAV planning chart that can serve the pilot not only during the preflight exercise, but for impromptu inflight needs as well.

(B) En Route Charts. Existing high and low altitude IFR en route charts are urgently in need of revising to accommodate and blend the needs of the RNAV user into the conventional airway structure. Most significant in this regard is the need for charting the "arrival" and "departure" fixes (gates) that exist in most metropolitan terminus airspace areas. Ostensibly this could be accommodated without undue chart clutter by the simple coining of a new symbol(s) which would

replace the conventional triangular symbol at these major fixes. This would aid the non-RNAV user as well as the RNAV user as both could initially plan a route of flight between these mandatory fixes. This would significantly reduce the need for in-flight routing changes, greatly reducing the workload of pilot and controller alike. The obviousness of this need is so overwhelming that one simply cannot contemplate any plausible justification for its continued omission.

(C) Instrument Approach Charts. Generally RNAV is thought of as only an en route navigation aid. However, this is only the tip of the iceberg. It is much more. When in terminal airspace and executing any type of instrument approach procedure establishing waypoints at key locations such as the outer marker, runway threshold, etc. can provide the pilot with an ongoing indication of bearing and distance that is invaluable for maintaining orientation and configuring the aircraft for the final descent segment. Controller workload is correspondingly reduced as the need for the controller to continually keep the pilot briefed of his position and progress during the vectoring sequence is eliminated.

However, to avail himself of this, the pilot must have available data, i.e., radial/distance or latitude and longitude as appropriate to input the onboard RNAV computer. This data is not always readily available. The chart makers have acknowledged this need to some extent by charting such data on selected ILS approach charts. This should be expanded to include charts of all types of instrument approach procedures.

SUFFIX

The suffix listed on the flight plan tells the controller what equipment the aircraft has on board and is available for use. For example, /R indicates among other things that the aircraft is equipped with approved RNAV equipment but offers no hint of the system(s) specific capabilities and limitations.

There are currently several diverse types of RNAV avionics equipment on the market. These generally fall into two operational categories:

Short Range RNAV (VOR/DME referenced) - This equipment requires considerable cockpit workload in the event the route of flight is appreciably changed while airborne. The pilot must redraw a new course line and develop new waypoints which is difficult, if not impossible, to do in the cockpit.

Long Range RNAV (VLF/Omega, INS, Loran-C, etc.) - The majority of course changes can easily be accepted merely by simple keyboard entry into the airborne computer ("present position-direct").

Beyond these two basic categories some RNAV systems can only be approved for en route use. Others can be approved for all certification categories, i.e., en route, terminal and approoch.

The suffix designator should therefore be expanded to indicate to the controller what specific onboard RNAV capabilities exist and those that the pilot is prepared to use.

Suggested suffix formats as it relates to RNAV are:

/RS3 approved RNAV, short-range and certified in all three categories (en route, terminal and approach).

/RL1 approved RNAV, long-range and certified for en route use only.

/RL3 approved RNAV, long-range and certified in all three categories.

If maximum utilization is to be realized from RNAV's capability, it is essential that the controller be informed of the aircraft's equipment capabilities and limitations and that he be personally equipped from an education and training standpoint to deal with these differences.

The often used excuse given for the lack of RNAV implementation that only relatively few aircraft are RNAV equipped is no longer valid. Conversely, virtually all new turbine-powered aircraft are being RNAV equipped and retrofitting of older aircraft is occurring at an ever quickening pace. We can no longer hide our heads in the sand.

STATEMENT OF MR. G.F. QUINBY

(The following is the text of an article submitted for publication in the monthly journal of the Aircraft Electronics Association.)

MLS for Reliable Arrival

In the beginning, it is visual flight rules. Cross-country excursions with your shiny new solo permit and later a proud private license, are fair weather affairs, and a deterioration into less than legal ceiling or visibility is cause for prudent course reversal or other evasive maneuvering. Most of the airplanes on the active list operate in a VFR Mode most of the time.

For many, there comes a time when the use of the airplane for transportation requires a somewhat higher degree of schedule adherence than that available to the VFR operator. It may be for a sales call or service appointment or the delivery of critical parts that cannot tolerate the 10 or 20 percent of the time that the weather does not permit safe VFR operations. When this improvement is accomplished, the aircraft is equipped to operate in instrument meteorological conditions and the pilot is trained to be proficient in the operation of the aircraft under instrument flight rules. Once this combination has established itself, schedule reliability improves remarkably. The percent of time that a flight cannot be completed to its destination with Category I precision approach minimums of 200 feet ceiling and one-half mile visibility, drops to a miniscule percentage of attempts. And for the vast majority of aircraft operators, the high

percentage completion of attempts to arrive safely in instrument meteorological conditions is adequate for their purposes. The few times when a competent pilot and a well-equipped airplane must execute a missed approach at Category I and proceed to an alternate destination do not seriously interfere with the reason for using the airplane for transportation in the first place.

During the decade of the 1960's, some aircraft operators, principally commercial, began to explore the need for improved schedule reliability. Category II was conceived and initiated which would permit a successful arrival in weather conditions below the classic 200 foot ceiling and half-mile visibility *provided* the aircraft was appropriately equipped and maintained and the crew was appropriately qualified and current. Category II operations were more popular in the European region than in the United States, which says something about the comparative climates. But those operators for whom the minor unreliability of operation in Category I minimums was not acceptable, now had an opportunity to invest in improved schedule reliability at designated airports and runways. It may have been the process of certificating operators for Category II arrivals using conventional instrument landing systems that led some system planners to suspect there may be a better way. The ILS had been around for twenty or thirty years and its limitations were fairly well defined. Given a good site, reasonably free from multi-path and other errors, stretching Category I towards Category II was reasonably practical of accomplishment. But not all sites were satisfactory for this stretch. In the late 1960's RTCA convened a special committee to examine alternatives to the venerable instrument landing system. Special Committee 117 concluded, after elaborate deliberations, that the microwave region was more suitable

for site-proof guidance signals than the VFR/UHF neighborhood of the ILS. SC-117 was chaired by S.B. Poritzky, then of the Air Transport Association, where the need for more arrival reliability was most keenly perceived.

During the decade of the '70's, the MLS was fleshed out by an official advisory committee, dressed up with implementation planning by another RTCA special committee (SC-125), demonstrated extensively throughout the world and adopted by the International Civil Aviation Organization (ICAO), as an international standard. In addition to its microwave azimuth and elevation angle guidance, MLS acquired a precision range measurement component compatible with the en route distance measuring equipment (DME) used in conjunction with VOR on well over a thousand VORTACs and VOR/DME ground facilities throughout the world. The precision DME (DME/P) which emerged as a component of the FAA's MLS, enjoyed its share of technical controversy simply because, unlike the angle system, it had not been prototyped and tested to the complete satisfaction of the critical community. Very little was known about the avionics cost increment involved in compliance with the evolving MLS DME/P standards.

But the 1982 Airport and Airway Development Act, prepared and presented by the administration and adopted by the Congress, included the microwave landing system program in its entirety. One consequence of this Act was the letting of a production procurement contract by FAA in early 1984 for somewhere between 170 and 200 initial production MLS facilities on a turnkey basis. All of these initial facilities included both angle and range signals. Hazeltine Corp. of Long Island was the successful bidder and will manufacture the angle guidance components. E-Systems, through their Salt Lake City, Utah, facility, is the contractor for

the DME/P ground transponder. Initial deliveries of ground facility hardware are confidently expected to start late next year with turnkey commissioning starting, probably, in early 1986.

FAA, guided somewhat by the report of RTCA Special Committee 125 on MLS implementation, found it necessary to suggest specific sites to the bidders in order that the cost of site preparation could be fairly estimated by the bidders responsible for turnkey availability. Predictably, many airspace users, starved for new precision approach guidance since the FAA cut off of ILS installations in anticipation of MLS, found fault with the FAA site selection. Shortly after the contract was let for ground facilities, a consortium of interested industry associations developed an alternate list of sites which appeared to have lots more expansion of precision approach capacity going for it. This alternate list is being considered by FAA and other interested components of the federal government as this is being written. There is even the possibility that some additional ILS installations will be released pending start of implementation of MLS ground facilities.

One peculiarity of the ILS/MLS transition is that MLS avionics, apparently, lag somewhat behind the design and development of MLS ground facilities. At least two avionics manufacturers have MLS angle receiver-processors available in their sophisticated product lines at prices in the high four figures. It is not known if any avionics manufacturer has committed product development money to any configuration of DME/P. This may be partly because of the RTCA special committee charged with developing minimum operational performance standards for DME/P is still immersed in the hard pick-and-shovel detail of performance standards, test criteria, test methodology, and so forth. Another RTCA special committee is exploring the feasibility and utility of MLS area navigation in the terminal area. MLS RNAV will use the azimuth and elevation angle guidance signals along

with the precision DME range signals to provide precise approach maneuvering down to the missed approach point. MLS with DME/P is capable of providing *landing* guidance, not merely approach guidance, down to a version of Category III which, in effect, says "you feel it before you see it."

Lest MLS be thought a unique US navigation function, be aware that Working Groups and Panels of ICAO with substantial participation from European and Asian governments have been generating standards and recommended practices (SARP's) for world wide implementation of the system. MLS will undoubtedly be included in upcoming discussions at a high level ICAO planning effort on future air navigation systems (FANS). Chief of the US delegation to FANS is S.B. Poritzky, now in FAA's office of the associate administrator for development and logistics.

The purveyors of large commercial passenger transport flying machinery will be equipping their aircraft with an instrument approach and landing guidance capability far in excess of that provided by even the best implementations of ILS. The path following accuracy and system integrity, not only in the navigation guidance system, but in the flight management system which connects the navigation to the flight control department, promises to improve schedule reliability another order of magnitude. There are, without question, operators to whom this improvement is clearly cost beneficial.

And, of course, there are operators who look at the cost of this increment of reliability with some suspicion. When these costs get sorted out in the next couple of years, there will be those who choose to go to the alternate if their first choice destination is below Category I minimums. The option for improved arrival reliability will have its price tags which will probably be decreasing through the decade of the '80's.

And there will still be that vast majority of flight operations which will discontinue their mission if the weather deteriorates below visual meteorological conditions.

Mr. COLLIER. Having listened to the comments this morning, one would ask himself, if RNAV is all this great, why hasn't it been implemented to a greater extent? Perhaps one could use the "which comes first, the chicken or the egg" question. In my judgment, it's simply because ATC personnel don't know much about RNAV's capabilities and limitations, and consequently, are reluctant to venture into its domain.

Even though RNAV was officially recognized by FAA and went so far as to establish a series of high-altitude RNAV routes at one time, they failed to equip those in the working end of the ATC system with the knowledge and direction to deal with it.

The business aircraft operator, somewhat unique because his destinations don't always lie on or near established airways and Navaids, soon learn that RNAV could provide the navigational support required. In view of this, and the difficulty members encountered with ATC in effectively using RNAV, the National Business Aircraft Association performed a dedicated RNAV committee in 1977.

After considerable study in analyzing inputs from its membership, several areas were identified that were having an adverse impact on RNAV utilization and implementation. This committee subsequently made recommendation to FAA in an effort to resolve these inhibitors.

Although these recommendations were made in 1977, they are still valid. I shall briefly review a few.

Education. The committee was appalled to learn that RNAV was not a formal part of the controller's curriculum or training programs, initially or recurrently. This, in spite of the fact that RNAV had been an official entity of the national airspace system for some time.

In this regard, I recall several years ago when navigating on an establish RNAV route, that I would be frequently queried: "Do you show on course?" or "How are you navigating?" My typical answer, "I show on course on J448R," which was usually followed by a period of silence.

Fortunately, this situation has improved today. However, many controllers still lack knowledge to effectively accommodate the RNAV user. This deficiency is likely to become even more significant as air carriers increasingly use RNAV in an effort to reduce operating costs.

RNAV procedures and limitations simply must be a part of every controller's training. Recognizing this, NBAA, in the late 1970's, prepared and distributed a document, "RNAV and the Controller," to appropriate ATC facilities in an effort to meet in part this need.

Another area that is inadequate is charting. Contemporary navigation charts are not responsive to the unique needs of the RNAV user. A primary concern is a planning chart suitable for both preflight and inflight use. Because the pilot must often develop waypoints to define his proposed route of flight for ATC purposes and for input of his onboard NAV system, some form of dedicated chart is needed. Although electronic calculators can be of help in this task, the need remains for a basic RNAV planning chart.

It is also of paramount importance that area and departure arrival fixes at major airports be appropriately depicted on standard

enroute and terminal area charts. These fixes currently are perhaps ATC's best-kept secret. Work loads of pilots and controllers would be greatly reduced by their charting as the need and frequency for revised routings would be reduced.

Instrument approach charts of all types should also list waypoint data at selected locations to enable the pilot to effectively use his RNAV as a flight management tool when operating in terminal approach arenas. To the surprise of many, the use of RNAV as an en route navigator is just the tip of the iceberg. Placing a waypoint at the outer marker or runway threshold can be of invaluable assistance to the pilot during the execution of any type of instant approach procedure.

The chartmakers have acknowledged this to some extent, providing this data on a limited number of ILS charts, about 44, I believe. This effort should be expanded forthwith to include all types of instrument approach charts.

Another area of needed attention is the flight planned suffix format which currently is /Romeo. Assuming the controller has a basic knowledge of RNAV, he should—he must also have, at least in general terms, a knowledge what the capability and limitations of different types of RNAV equipment are. Is it short-range, long-range, approved for instrument approaches, terminal use? Not all systems are. Consequently, the flight plan suffix format should be expanded to reveal this important information.

RNAV instrument approach procedures. RNAV provides a means for establishing instrument approach procedures to most airports, predicated on a nearby VOR facility. This can be a particularly significant at those airports that cannot afford or justify the cost of on-site approach aids, and it is this type of airport that many business aircraft frequent.

RNAV also offers the option of a straight-in approach procedure to all runways, eliminating the often precipitous circling approach. Consequently, efforts should be increased on the part of FAA to increase RNAV approach procedures to all airports where a need exists.

Fundamental to this effort is to inform the public of the availability of this procedure and make it known that no costs will be incurred to the airport operator. Effort should also be increased to explore the use of LORAN C as an approach aid. This mode of navigation, although originally intended for marine use, has grown rapidly in popularity as an airport—primarily as an airport navigation system, due to its relatively low cost and ability to perform at altitudes below VOR/DME usable line-of-sight signals.

Mr. GLICKMAN. Mr. Cooke, we're kind of in a time bind——

Mr. COLLIER. Yes.

Mr. GLICKMAN [continuing]. Is there any way you could summarize your statement——

Because your entire statement will appear in the record.

Mr. COLLIER. Yes. All right, I can summarize by saying that—that what most corporate aircraft, business corporate aircraft, turbine-powered aircraft are equipped with RNAV and the major restraint we're encountering is ATC themselves, the controller. They

just haven't been taught anything about it; they don't know how it works.

That would be a relatively inexpensive thing to do to increase the education of these controllers. Let us use a system that we have now.

OK, thank you, sir.

[The prepared statement of Mr. Collier follows:]

COMMENTS ON AREA NAVIGATION

BY

M. W. COLLIER

Area navigation (RNAV) has been around for nearly two decades. However, it has only been in recent years that its potential to meet many of the needs and challenges of the expanding navigational arena has become recognized. The acknowledgment of RNAV's unique value has occurred in spite of a lack of forceful initiative on the part of the Federal Aviation Administration.

Emerging on its own merit, perhaps it can be said that RNAV is a system of navigation whose time has come. Nor should it go unnoted that RNAV's increasing acceptance and usefulness have been assisted to no small degree by developing and applied electronic technology. Technology that has dissolved many of RNAV's early operational shortcomings.

Ironicallly, however, the proliferation of RNAV through technology has resulted in diverse types of RNAV systems which have contributed to some degree to misconceptions and lack of a clear understanding of what the term RNAV really encompasses.

As defined in the Airman's Information Manual, Pilot/Controller Glossary:

> Area navigation/RNAV is a method of navigation that permits aircraft operations on any desired course within the coverage of station-referenced navigational signals or within the limits of self-contained system capability. The International (IACO) definition adds, "or a combination of these" which perhaps better describes evolving RNAV systems.

Simply stated, regardless of the nav sensor used or the degree of automation or sophistication employed, an RNAV system allows the pilot to navigate randomly and at will, direct to any point in space without the need and encumbrance of meandering from one navaid to another. Obviously, this can save time, energy and money.

Equally significant, RNAV offers the potential to alleviate en route air traffic congestion by circumventing the traditional and outmoded procedure of routing (bunching) aircraft along a common route of flight while adjacent airspace goes unused. Also, if effectively applied, RNAV can reduce controller workloads. Wasted airspace and human resources are luxuries that simply can no longer be tolerated in our Nation Airspace System.

Included among contemporary RNAV systems are VOR/DME-referenced systems, VLF/Omega, Inertial (INS), Loran-C and hybrid systems combining two or more different RNAV systems in a compound unit. Also, a satellite-based global positioning system (GPS) is currently under development.

The VOR/DME RNAV system is considered a short-range system, while the others are considered to be long-range systems. Because each in its own way has advantages and disadvantages that can directly impact pilot workload, it is essential that the ATC controller have a knowledge of each system's capabilities and limitations. More on this later.

The professional corporate pilot has led the way in the practical application of RNAV concepts and procedures. Because he is often required to operate to "outlying" airports that often are not served by dedicated on-site navaids, he quickly learned that RNAV could provide the navigational

support needed. Additionally, some RNAV systems provided "instrument approach" guidance to airports that otherwise would not be accessible during inclement weather.

A major obstacle the corporate pilot encountered when attempting to use RNAV routings was the "system", the Air Traffic Control System. This somewhat inflexible combination of people and concepts ostensibly found it difficult to accept the fact that a pilot could navigate to some point in space which did not lie on an established airway or was not served by some type of conventional navaid without radar assistance.

The irony of all this was that the ATC controller was increasingly assuming the role of aircraft navigator. Consequently, he often became overloaded and was distracted from his intended function of keeping aircraft separated. Nor was this subtle encroachment resisted by some pilots who were quite willing to acquiesce the responsibility for navigating their aircraft.

The initial difficulty of effectively using RNAV was in spite of the fact that the FAA, after extensive in-depth studies, had endorsed the concept of RNAV. At best, perhaps, one could say that FAA extended only cursory efforts which provided little tangible benefit to the aspirant RNAV pilot.

In part, because of continued pressure from various segments of the aviation community, FAA's RNAV position was reviewed, updated and presented in the form of a policy statement issued in Washington, D.C., on January 7, 1977.

In response to FAA's reaffirmed position the National Business Aircraft Association (NBAA) issued its own RNAV policy statement on January 24, 1977, applauding FAA's position and solicited active membership participation in the development of effective RNAV utilization.

In this document NBAA correctly identified the primary key, in my judgment, to the implementation of RNAV in the ATC system - the air traffic controller. It was noted that the controller had a problem when the flexibility of the system exceeded what he thought was his required span of control. He (the controller) was not convinced that the pilot could accurately identify his position in space. It was postulated that until he (the controller) is disabused from this philosophy, RNAV routing will only be utilized on a limited basis. This assessment has been proven correct.

Additionally, NBAA requested of its membership that those having a working knowledge of RNAV equipment and procedures make a point of taking controllers on familiarization rides and to visit ATC facilities to explain how RNAV can effectively be used. Doing this it was believed would add to the controller's knowledge when FAA established the formal RNAV training program it had proposed.

In an effort to keep the RNAV ball rolling and to assist FAA in their rekindled interest, NBAA formed a dedicated RNAV committee consisting of active RNAV users from among its membership. A two-day meeting was convened at NBAA headquarters in Washington, D.C. on May 12, 1977. Included also were invited attendees from FAA and Aircraft Owners and Pilot Association (AOPA).

This working group identified several areas of immediate concern and formulated recommendations based upon impirical data and first-hand experience in an effort to resolve these deficiencies. The recommendations were forwarded to the FAA with an ongoing offer of assistance to expedite the orderly implementation of RNAV into the existing ATC system.

Because the deficiencies and recommendations identified by the committee in 1977 are still germane and need for their resolve is still paramount, a brief listing follows:

EDUCATION

Originally a major roadblock and currently a major restraint to effective RNAV utilization is the fact that many controllers simply don't know much about RNAV. This is a tragedy. Controllers can and must become learned regarding all navigation systems approved for use in the Nation Airspace System. Familiarization rides would be helpful and are recommended. Most importantly, however, increased emphasis on RNAV operations and its use in the ATC system must be included in FAA Academy prospectus.

Handbooks 7110.65 and 7110.10 should be updated to insure that adequate RNAV guidance is provided to controllers and specialists.

Expanded discussion in the Airman's Information Manual (AIM), Part I, in RNAV flight operations and the proper method of planning and filing RNAV flights should be carried out. Information in the AIM and Controller Handbook (7110.65) should be consistent.

Because the importance of RNAV knowledge on the part of the controller was deemed so important and in view that FAA provided no suitable text,

NBAA in the late 1970s developed a document called "RNAV and The Controller". This work was distributed to all appropriate FAA/ATC facilities and its reproduction and use for in-house RNAV training activities was encouraged. The response was most gratifying and it is humbly believed that this effort made a major contribution to the increased understanding and use of RNAV that have occurred in recent years.

CHARTING

(A) Planning chart. No fully adequate planning chart currently exists that is unique for meeting the demands of planning and developing an RNAV route of flight. This has been a major restraint for the RNAV user and undoubtedly has been a deterrent to greater RNAV utilization. A lack of pilot supplied RNAV waypoint data can also overload the controller and may result in the controller denying RNAV routing requests.

Although hand-held electronic calculators show promise in this area, a need exists for an RNAV planning chart that can serve the pilot not only during the preflight exercise, but for impromptu inflight needs as well.

(B) En Route Charts. Existing high and low altitude IFR en route charts are urgently in need of revising to accommodate and blend the needs of the RNAV user into the conventional airway structure. Most significant in this regard is the need for charting the "arrival" and "departure" fixes (gates) that exist in most metropolitan terminus airspace areas. Ostensibly this could be accommodated without undue chart clutter by the simple coining of a new symbol(s) which would

replace the conventional triangular symbol at these major fixes. This would aid the non-RNAV user as well as the RNAV user as both could initially plan a route of flight between these mandatory fixes. This would significantly reduce the need for in-flight routing changes, greatly reducing the workload of pilot and controller alike. The obviousness of this need is so overwhelming that one simply cannot contemplate any plausible justification for its continued omission.

(C) Instrument Approach Charts. Generally RNAV is thought of as only an en route navigation aid. However, this is only the tip of the iceberg. It is much more. When in terminal airspace and executing any type of instrument approach procedure establishing waypoints at key locations such as the outer marker, runway threshold, etc. can provide the pilot with an ongoing indication of bearing and distance that is invaluable for maintaining orientation and configuring the aircraft for the final descent segment. Controller workload is correspondingly reduced as the need for the controller to continually keep the pilot briefed of his position and progress during the vectoring sequence is eliminated.

However, to avail himself of this, the pilot must have available data, i.e., radial/distance or latitude and longitude as appropriate to input the onboard RNAV computer. This data is not always readily available. The chart makers have acknowledged this need to some extent by charting such data on selected ILS approach charts. This should be expanded to include charts of all types of instrument approach procedures.

SUFFIX

The suffix listed on the flight plan tells the controller what equipment the aircraft has on board and is available for use. For example, /R indicates among other things that the aircraft is equipped with approved RNAV equipment but offers no hint of the system(s) specific capabilities and limitations.

There are currently several diverse types of RNAV avionics equipment on the market. These generally fall into two operational categories:

Short Range RNAV (VOR/DME referenced) - This equipment requires considerable cockpit workload in the event the route of flight is appreciably changed while airborne. The pilot must redraw a new course line and develop new waypoints which is difficult, if not impossible, to do in the cockpit.

Long Range RNAV (VLF/Omega, INS, Loran-C, etc.) - The majority of course changes can easily be accepted merely by simple keyboard entry into the airborne computer ("present position-direct").

Beyond these two basic categories some RNAV systems can only be approved for en route use. Others can be approved for all certification categories, i.e., en route, terminal and approach.

The suffix designator should therefore be expanded to indicate to the controller what specific onboard RNAV capabilities exist and those that the pilot is prepared to use.

Suggested suffix formats as it relates to RNAV are:

/RS3 approved RNAV, short-range and certified in all three categories (en route, terminal and approach).

/RL1 approved RNAV, long-range and certified for en route use only.

/RL3 approved RNAV, long-range and certified in all three categories.

If maximum utilization is to be realized from RNAV's capability, it is essential that the controller be informed of the aircraft's equipment capabilities and limitations and that he be personally equipped from an education and training standpoint to deal with these differences.

The often used excuse given for the lack of RNAV implementation that only relatively few aircraft are RNAV equipped is no longer valid. Conversely, virtually all new turbine-powered aircraft are being RNAV equipped and retrofitting of older aircraft is occurring at an ever quickening pace. We can no longer hide our heads in the sand.

Mr. GLICKMAN. Thank you.
Mr. O'Brien, of the Air Line Pilots——
Mr. CARNEY. We've got one more.
Mr. GLICKMAN. Oh, we do?
Mr. QUINBY. I'll be brief, Mr. Chairman.
Mr. GLICKMAN. OK. Oh, Mr. Collier, OK.
Mr. QUINBY. My name is Mr. Quinby.
Mr. GLICKMAN. Quinby, OK, excuse me.
Mr. QUINBY. And I appreciate the fact that my remarks are in the transcript record, so it will not be necessary to go through that detail.

A little bit of my background. I've been in aviation electronics all my professional career. I had the privilege of serving on the MLS Advisory Committee 10 years or so ago to the FAA. I have been flying one of Wichita's finer piston products equipped with good avionics from a manufacturer that I worked for until 5 years ago, and I would like to add to what some of the other witnesses have said, some thoughts on the way these systems come into being, get planned, get implemented, get priced, and eventually get obsoleted.

The technology of electronics, coupled with the technology of aviation, is a very fast-moving, vital action. When an RTCA, radio technical commission for aeronautics special committee first looked at the final approach stage of flight in the late 1960's with special

committee 117, they then, industry, Government, users, manufacturers felt that while the ILS was adequate to the needs of that day, it would not be in the predictable future. As a result, they came up with a recommendation that precision approach guidance go to the microwave region for improved signal integrity, stability, accuracy, and coverage.

Now, we are in the process of implementing a plan which was internationally accepted only some 6—5 or 6 years ago. The progress that we have made toward that implementation in the past couple of years has been, to me, a welcome acceleration toward the implementation of MLS.

There are, however, some additional considerations that the committee should be aware of. I was pleased to hear that the manufacturer of the MLS ground facility will be producing at a rate of five equipments per month starting in 1986. I hope that the MLS approach procedure designers in FAA and elsewhere will be geared up to provide the procedures that it takes to get the good out of an MLS installation once it is commissioned on a site.

I hope that the avionics standards against which manufacturers will provide the MLS receiver processors for large and small airplanes will be wisely drawn. Two or three committees of the same RTCA are presently working on such things as how much protection against what kind of radio frequency interference must the new precision DME component of MLS have?

If questions such as this are not thoroughly studied and wisely answered, there could be bugs that you would not welcome.

Another is the MLS Navigation Committee which was mentioned earlier, that Special Committee 151. It must be remembered that the MLS approach can take place with precision in a large, relatively large volume of airspace approaching the arrival runway, rather than on single line, which is the limitation of the ILS.

Here, in order to use that volume wisely and so as to use it to feed the runway at an optimum rate, procedures have to be designed. The basic criteria for those procedures are being developed in RTCA. FAA will inherit the pick-and-shovel work of checking the obstruction clearance planes at each and every site of each and every runway approach before the MLS will be able to fulfill its mission.

Finally, the price of a component of MLS will be determined by the marketplace, marketplace as it is assessed by the avionics manufacturer. He has had—not had a chance to assess that marketplace yet. It takes him about 1½ to 2 years to get a product into the marketplace after he decides that there will be a market for that when it gets there. He will not foolishly rush a new design into production in the present situation in the general aviation marketplace until he is relatively sure that there will be customers waiting to buy it.

I thank you, gentlemen, and turn this chair task to Bob Cooke.

[The prepared statement of Mr. Quinby follows:]

STATEMENT OF MR. G.F. QUINBY

(The following is the text of an article submitted for publication in the monthly journal of the Aircraft Electronics Association.)

MLS for Reliable Arrival

In the beginning, it is visual flight rules. Cross-country excursions with your shiny new solo permit and later a proud private license, are fair weather affairs, and a deterioration into less than legal ceiling or visibility is cause for prudent course reversal or other evasive maneuvering. Most of the airplanes on the active list operate in a VFR Mode most of the time.

For many, there comes a time when the use of the airplane for transportation requires a somewhat higher degree of schedule adherence than that available to the VFR operator. It may be for a sales call or service appointment or the delivery of critical parts that cannot tolerate the 10 or 20 percent of the time that the weather does not permit safe VFR operations. When this improvement is accomplished, the aircraft is equipped to operate in instrument meteorological conditions and the pilot is trained to be proficient in the operation of the aircraft under instrument flight rules. Once this combination has established itself, schedule reliability improves remarkably. The percent of time that a flight cannot be completed to its destination with Category I precision approach minimums of 200 feet ceiling and one-half mile visibility, drops to a miniscule percentage of attempts. And for the vast majority of aircraft operators, the high

percentage completion of attempts to arrive safely in instrument meteorological conditions is adequate for their purposes. The few times when a competent pilot and a well-equipped airplane must execute a missed approach at Category I and proceed to an alternate destination do not seriously interfere with the reason for using the airplane for transportation in the first place.

During the decade of the 1960's, some aircraft operators, principally commercial, began to explore the need for improved schedule reliability. Category II was conceived and initiated which would permit a successful arrival in weather conditions below the classic 200 foot ceiling and half-mile visibility *provided* the aircraft was appropriately equipped and maintained and the crew was appropriately qualified and current. Category II operations were more popular in the European region than in the United States, which says something about the comparative climates. But those operators for whom the minor unreliability of operation in Category I minimums was not acceptable, now had an opportunity to invest in improved schedule reliability at designated airports and runways. It may have been the process of certificating operators for Category II arrivals using conventional instrument landing systems that led some system planners to suspect there may be a better way. The ILS had been around for twenty or thirty years and its limitations were fairly well defined. Given a good site, reasonably free from multi-path and other errors, stretching Category I towards Category II was reasonably practical of accomplishment. But not all sites were satisfactory for this stretch. In the late 1960's RTCA convened a special committee to examine alternatives to the venerable instrument landing system. Special Committee 117 concluded, after elaborate deliberations, that the microwave region was more suitable

for site-proof guidance signals than the VFR/UHF neighborhood of the ILS. SC-117 was chaired by S.B. Poritzky, then of the Air Transport Association, where the need for more arrival reliability was most keenly perceived.

During the decade of the '70's, the MLS was fleshed out by an official advisory committee, dressed up with implementation planning by another RTCA special committee (SC-125), demonstrated extensively throughout the world and adopted by the International Civil Aviation Organization (ICAO), as an international standard. In addition to its microwave azimuth and elevation angle guidance, MLS acquired a precision range measurement component compatible with the en route distance measuring equipment (DME) used in conjunction with VOR on well over a thousand VORTACs and VOR/DME ground facilities throughout the world. The precision DME (DME/P) which emerged as a component of the FAA's MLS, enjoyed its share of technical controversy simply because, unlike the angle system, it had not been prototyped and tested to the complete satisfaction of the critical community. Very little was known about the avionics cost increment involved in compliance with the evolving MLS DME/P standards.

But the 1982 Airport and Airway Development Act, prepared and presented by the administration and adopted by the Congress, included the microwave landing system program in its entirety. One consequence of this Act was the letting of a production procurement contract by FAA in early 1984 for somewhere between 170 and 200 initial production MLS facilities on a turnkey basis. All of these initial facilities included both angle and range signals. Hazeltine Corp. of Long Island was the successful bidder and will manufacture the angle guidance components. E-Systems, through their Salt Lake City, Utah, facility, is the contractor for

the DME/P ground transponder. Initial deliveries of ground facility hardware are confidently expected to start late next year with turnkey commissioning starting, probably, in early 1986.

FAA, guided somewhat by the report of RTCA Special Committee 125 on MLS implementation, found it necessary to suggest specific sites to the bidders in order that the cost of site preparation could be fairly estimated by the bidders responsible for turnkey availability. Predictably, many airspace users, starved for new precision approach guidance since the FAA cut off of ILS installations in anticipation of MLS, found fault with the FAA site selection. Shortly after the contract was let for ground facilities, a consortium of interested industry associations developed an alternate list of sites which appeared to have lots more expansion of precision approach capacity going for it. This alternate list is being considered by FAA and other interested components of the federal government as this is being written. There is even the possibility that some additional ILS installations will be released pending start of implementation of MLS ground facilities.

One peculiarity of the ILS/MLS transition is that MLS avionics, apparently, lag somewhat behind the design and development of MLS ground facilities. At least two avionics manufacturers have MLS angle receiver-processors available in their sophisticated product lines at prices in the high four figures. It is not known if any avionics manufacturer has committed product development money to any configuration of DME/P. This may be partly because of the RTCA special committee charged with developing minimum operational performance standards for DME/P is still immersed in the hard pick-and-shovel detail of performance standards, test criteria, test methodology, and so forth. Another RTCA special committee is exploring the feasibility and utility of MLS area navigation in the terminal area. MLS RNAV will use the azimuth and elevation angle guidance signals along

with the precision DME range signals to provide precise approach mancuvering down to the missed approach point. MLS with DME/P is capable of providing *landing* guidance, not merely approach guidance, down to a version of Category III which, in effect, says "you feel it before you see it."

Lest MLS be thought a unique US navigation function, be aware that Working Groups and Panels of ICAO with substantial participation from European and Asian governments have been generating standards and recommended practices (SARP's) for world wide implementation of the system. MLS will undoubtedly be included in upcoming discussions at a high level ICAO planning effort on future air navigation systems (FANS). Chief of the US delegation to FANS is S.B. Poritzky, now in FAA's office of the associate administrator for development and logistics.

The purveyors of large commercial passenger transport flying machinery will be equipping their aircraft with an instrument approach and landing guidance capability far in excess of that provided by even the best implementations of ILS. The path following accuracy and system integrity, not only in the navigation guidance system, but in the flight management system which connects the navigation to the flight control department, promises to improve schedule reliability another order of magnitude. There are, without question, operators to whom this improvement is clearly cost beneficial.

And, of course, there are operators who look at the cost of this increment of reliability with some suspicion. When these costs get sorted out in the next couple of years, there will be those who choose to go to the alternate if their first choice destination is below Category I minimums. The option for improved arrival reliability will have its price tags which will probably be decreasing through the decade of the '80's.

And there will still be that vast majority of flight operations which will discontinue their mission if the weather deteriorates below visual meteorological conditions.

Mr. GLICKMAN. Thank you very much, Mr.—appreciate it, Mr. Quinby.

Why don't you go ahead. Do you have somebody?

Mr. O'BRIEN. Thank you, Mr. Chairman.

I want to express Jack Howell's apologies for not being here this morning. He is a pilot for a major airline who is having pilot scheduling problems because of all the delays in the air traffic control system. [Laughter.]

We represent 34,000 pilots who fly for 45 major airlines, and with me today is Tom Kramer, who is the vice chairman of operations for the Air Traffic Control Committee.

We appreciate this opportunity to appear before you to present our views on how—or in regard to the question of whether we are attaining the maximum advantage new technology can afford in safety and traffic congestion relief.

As noted by the subcommittee, area navigation, short take-off and landing techniques, and the microwave landing system are now quite mature. However, the performance of our air traffic control system this summer has shown us that the painful truth that these technologies are neither affording significant advantages in traffic congestion relief, nor air safety, either separately or as combined in the systems.

This deplorable situation requires that two questions be answered: What is the contribution to safety and congestion relief of these technologies, and what is their eventual place in the national airspace system? Rather than going into that in any detail, I would just like to acknowledge that everything that has been stated this morning about area NAV, MLS and other advanced technologies, we fully support. They are mature; they are necessary if we're to get the overall system capacity that is needed today.

I would even agree with Bob's statements that maybe MLS isn't really needed for general aviation capacity, but it is needed for other components of the air navigation system to increase capacity for all users. So, I'd rather concentrate on what else can be done to provide immediate relief from the present situation.

A good place to look for answers to that question can be found in the report of the "Industry Task Force on Airport Capacity Improvements in Delay Reductions," which is dated September 29, 1982. There's seven main areas that this task force went into, seven areas that would produce immediate capacity improvements within the system: Wake vortex; air traffic control capacity improvements; integrated flow management; airport runway/taxiway systems; land side issues; institutional/socioeconomic issues; and human factors.

This report provided several recommendations, some of which have been acted on by FAA; some of which are in the process of being acted on; and some of which haven't been acted on at all. The ones that haven't been acted on at all are all lumped into high-cost items. In other words, it would cost us something to implement them. So, therefore, those items were deferred.

To get out of this predicament, we don't need more studies to determine what needs to be done. We have a blueprint for the progress in the task force report. What we do need is action in the following areas: compiling results of past studies; initiating re-

search to solve problems associated with the task force recommendations; developing operational solutions to new procedures.

This action can best be taken by FAA alone, and in some cases, in joint FAA/NASA programs.

Mr. Chairman, you are aware that we have advocated and supported such programs in the past as it is the best way to blend from both agencies into viable solutions to tough problems. Getting started along this course of action requires the FAA to be able to locate a source of funding for such efforts. You see, the FAA attitude about taking action only on the cheap changes is not the one they desire, but one that is necessary because of financial constraints.

There is one obvious answer: the Airport Improvement Fund. Over $3 billion of air travelers' money has been amassed in that fund through passenger taxes. These people now have a lot of time on their hands to think about where their money went as they sit at airports waiting for delays.

It is only right that these taxes be earmarked for capacity improvements to eliminate these delays. What we're talking about, Mr. Chairman, are things like were referred to earlier today about using intersecting runways or closely spaced parallel runways, things that could be done today, right now.

Obviously, there are procedural problems with some of them; they have to be worked out, but they can be worked out. We, as well as many other members of that Capacity Task Force, unanimously adopted these recommendations. It was a unanimous report and it is a report that can be acted on today.

[The prepared statement of Mr. Howell follows:]

STATEMENT OF

JACK D. HOWELL

CHAIRMAN, AIR TRAFFIC CONTROL COMMITTEE

AIR LINE PILOTS ASSOCIATION

BEFORE THE

SUBCOMMITTEE ON TRANSPORTATION, AVIATION AND MATERIALS

COMMITTEE ON SCIENCE AND TECHNOLOGY

U. S. HOUSE OF REPRESENTATIVES

JULY 24, 1984

AIRCRAFT NAVIGATION AND LANDING TECHNOLOGY

Mr. Chairman and members of the Subcommittee, I am Jack Howell, Chairman of the Air Traffic Control Committee of the Air Line Pilots Association. ALPA represents the professional interests of over 34,000 pilots who fly for 45 airlines. With me today is John O'Brien, Director of ALPA's Engineering and Air Safety Department. We appreciate this opportunity to appear before you today to present the views of ALPA in regard to the question of whether we are attaining the maximum advantage new technology can afford in safety and traffic congestion relief.

As noted by the subcommittee, Area Navigation (R-NAV), Short Takeoff and Landing (STOL) techniques, and Microwave Landing Systems (MLS) are now quite mature. However, the performance of our Air Traffic System (ATS) this summer

has shown us the painful truth that these technologies are neither affording significant advantages in traffic congestion relief nor air safety, either separately or as combined into systems. This deplorable situation requires that two questions be answered:

- What is the contribution to safety and congestion relief of these technologies and what is their eventual place in the National Air Space System?

- What else can be done to provide relief for the present situation?

Area Navigation creates the possibility for random routes which can allow aircraft to spread out over a wide area rather than being concentrated on narrow aerial highways, but employment of this concept requires very labor-intensive surveillance which is very expensive to provide. Area Navigation also provides the capability for many direct routes which can offer significant savings in terms of fuel. The capability of having random routes becomes even more valuable in the terminal area as better use of the Microwave Landing Systems can be employed by allowing the aircraft to join turning final approach courses to runways from a variety of directions or routes in the terminal area.

STOL technologies also are valuable for airport capacity. They allow more access to existing airports by permitting the kinds of aircraft with those characteristics to use shorter runways than the Conventional Takeoff and Landing (CTOL) aircraft. The employment of STOL technologies and aircraft provide more access to urban centers by allowing the approach of those kinds of airplanes to new sites which can be a good distance away from existing CTOL airports. STOL technology also has the advantage of being able to provide

noise relief through the use of approach profiles with steeper descent gradients as well as allowing new approach routes to an airport where shorter runways may be added in remote areas of the airport away from CTOL runways. But these advantages are not without cost. The cost items are the special aircraft themselves along with the addition of the runways on which they are to land and the ground-based navigation systems for the approaches.

The Microwave Landing System (MLS) is one such ground-based approach system which can allow pilots to use STOL techniques. The Microwave Landing System has the advantage of offering very precise guidance, and in some instances where terrain difficulties are encountered, it can provide guidance where standard Instrument Landing Systems (ILS) will not work. The MLS can also provide for curved paths to a runway which will allow for distribution of noise and wake turbulence, thus permitting a reduction of longitudinal separations of aircraft in the terminal area. But again this technology is not providing much congestion relief at this time because of the cost of implementing these systems.

So there is a sizable contribution these technologies can make, but none of them are being utilized widely enough to make any significant difference. The reason is one of cost.

To enjoy the level of safety the air passenger deserves and to keep the level of service the public expects, these and other technologies will have to become an integral part of the National Airspace System.

The second and perhaps more pressing question to be addressed today is: "What else can be done to provide relief for the present situation?"

A good place to look for answers to that question can be found in the Report of the Industry Task Force on Airport Capacity Improvements and Delay Reductions dated September 29, 1982. The major recommendations of that task force were divided into seven categories:

- Wake Vortex Improvements
- Air Traffic Control Capacity Improvements
- Integrated Flow Management and Associated Concepts
- Airport Runway/Taxiway Systems
- Land Side Issues
- Institutional/Socio-Economic Issues
- Human Factors

All of that activity occurred two years ago, so you might think that we are well on the way to solving the capacity problem. But, alas, you don't have to be told that we are not doing so well.

Did anything happen to those recommendations to the FAA? Frankly, yes, some action was taken, but the criterion by which these changes were implemented was cost. The FAA attitude was if it is cheap, do it; if it costs money, study it some more! Gentlemen, that is what happened in 1982 and 1983 when traffic was down because of artificial constraints placed on the air traffic control system by the FAA due to the 1981 controllers' strike. The FAA lost two years of time for hard research, and now we are paying the price.

To get out of this predicament, we don't need more studies to determine what needs to be done; we have a blueprint for progress in the Task Force Report.

What we do need is action in the following areas:

- Compiling results of past studies
- Initiating research to solve problems associated with the Task Force Recommendations
- Developing operational solutions of new procedures/solutions

This action can best be taken by FAA alone and, in some cases, in joint FAA/NASA programs. Mr. Chairman, you are aware that we have advocated and supported such programs in the past as it is the way to blend the best from both agencies into viable solutions to tough problems.

Getting started along this course of action requires that FAA be able to locate a source of funding for such efforts. You see, the FAA attitude about taking action only on the cheap changes is not one they desire, but one that is necessary because of financial constraints.

There is one obvious answer: The Airport Improvement Fund. Over three billion dollars of air travelers' money have been amassed in that fund through air passenger taxes. These people now have a lot of time on their hands to think about where their money went as they sit in airports absorbing delays. It is only right that these taxes be earmarked for capacity improvements to eliminate these delays.

Mr. GLICKMAN. Thank you, Mr. O'Brien.

Mr. Ransome, it's a pleasure to have you here. Mr. Carney was commenting to me how much he enjoys flying Ransome and I have, as well, enjoyed flying you.

Mr. RANSOME. Thank you very much. A hell of a name for an airline, but we're going to stick with it for a while, I think. [Laughter.]

Mr. Chairman, I'm very honored to be here today and have an opportunity to express some very brief thoughts because I think I can be a lot more effective in answering questions than I can by elaborating on our paper that was submitted.

I have with me Frank Foster, who is our chief pilot today, and also Dan Santor, and I'm particularly happy to see my friend, Scott, down there at the other end, who I consider to be, certainly if not the foremost, one of the foremost authorities in this area. He's had a lot of practical experience and spent an awful lot of time, and really, it is the result of what he's done that got me somewhat stimulated—or his interest, years ago.

I guess the question asked is: Are we attaining the maximum advantage from RNAV, STOL and MLS afforded us today in safety and congestion relief separately or as combined into a flight navigation system. From the safety standpoint, I'd say yes; from the—from the other aspect, certainly we're very frustrated today.

We—we see airport access as being a severe and major challenge to our industry, not just the regionals and commuters, but the major carriers, and we get more frustrated every day and we're losing more money every day so we are very, very concerned. We think that in general we need a specific office within the FAA that we can go to or certainly somebody that's going to honcho some of these new concepts which—and I'll speak to this a little bit later on as to how we have progressed to date. We think we've progressed very, very well. We're not the only answer. Our concept is not the only answer, but it can provide a major relief to some of the problems, and as Mr. Sandford indicated a little bit earlier, it's not just STOL aircraft; it's a basic concept that is expandable to other airports and should be addressed very, very quickly as a practical improvement to our problems today.

I was involved in the task force in 1982. It was recommended that our program be put into practial application as soon as possible in that it did not impact the taxpayer in any sense. We have invested something in the order of $250,000 to $300,000 per aircraft just to have this advantage.

Now, over and above that, our company—and we are a relatively small private company—have invested some $26 million in specific aircraft and hardware to try and solve a problem that we've been fighting ever since we've been in business for over 20 years—close to 20 years now—at Washington National.

I might add that at Washington, we've had exceptionally good receptivity. We have a unique situation at National where the air traffic controllers there are sold on the concept, have been very supportive, and we've seen the practical results of what can be done, and I also might add that we appreciate the cooperation that we've had from ALPA and the other airlines in working with us in working this approach out.

I'm sure in the early stages that they might have been a little bit apprehensive, but they have been very supportive, and we think we can contribute a tremendous amount to the solution.

The kinds of problems that we see today are typical, I guess, of trying to pioneer or do something new and I think we're way beyond the pioneering stage in that we've got—we have shot probably between 10 and 20 simultaneous approaches at National Airport. We've been doing this for almost 5 years. We are still waiting to get our first IFR approach there. We cannot get this accomplished, although it's been recommended. It's hung up in the FAA and I must tell you that we cannot move it. We see no reason for this and, quite frankly, we're very, very frustrated.

We see the—I think ADAP and what's going to come in the next decade is certainly going to contribute to a solution, but we think that what we're doing can move a little quicker than that and basically, we have a system today that is virtually autoflight between Philadelphia and Washington, DC. We have a—routes in JFK in New York using the cross runways up there that we can't get approved when they're approved by every segment that has to be involved, the military up at McGuire, Philadelphia and New York, but we cannot get it into operation and we get the typical answers that this—we just can't do it that way.

I certainly don't want to reflect negatively on the FAA. I am reflecting, I guess, my frustration over the fact that I really believe in this. I believe, not in it just for Ransome Airlines, but for the industry as a whole, and I think we can move considerably faster than we are if we can get that individual or group of individuals or somebody within the FAA that will focus on taking a look at new technology as an individual, not as an individual or group of individuals, and help us get this substantial improvement that we have capable of—that we are capable of doing today into place.

It's been said, I think, and I believe this very truly, that there've been more technological advance in the past decade than all mankind previous. Our problem is we can't get it into operation.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Ransome follows:]

STATEMENT OF

J. DAWSON RANSOME

PRESIDENT

RANSOME AIRLINES

BEFORE THE

SUBCOMMITTEE ON TRANSPORTATION

AVIATION AND MATERIALS

CONGRESSMAN DAN GLICKMAN, CHAIRMAN

JULY 24, 1984

MR. CHAIRMAN, I AM VERY PLEASED TO HAVE THIS OPPORTUNITY TO TESTIFY TODAY ON 3D R-NAV, MLS AND S.T.O.L. I AM PARTICULARLY HAPPY TO SEE MY OLD FRIEND SCOTT CROSSFIELD HERE AS I CONSIDER HIM THE FOREMOSE AUTHORITY ON THE SUBJECTS WE WILL BE DISCUSSING TODAY.

I WOULD LIKE TO QUOTE FROM THE PREFACE OF THE NATIONAL AIRWAYS SYSTEMS REPORT FO THE SECRETARY OF TRANSPORTATION TO THE UNITED STATES CONGRESS, PUBLISHED IN APRIL 1984.

I QUOTE "1983 REPRESENTED THE 25TH ANNIVERSARY OF THE SIGNING OF THE FEDERAL AVIATION ACT OF 1958, THE GENESIS OF TODAY'S FEDERAL AVIATION ADMINISTRATION.

THE FAA WAS FORMED TO MEET THE CHALLENGES OF THE EXPANDING AVIATION TECHNOLOGY THAT MARKED THE EARLY JET AGE. THE PRIMARY AND IMMEDIATE NEED WAS TO REPLACE THE NATION'S OUTDATED SYSTEM OF AIR TRAFFIC CONTROL AND AIR NAVIATION WITH A SINGLE MODERN SYSTEM THAT WOULD SERVE THE AIRLINES, GENERAL AVIATION, AND THE MILITARY.

THE CHALLENGE WAS MET BY THE NEW AGENCY. BY HARNESSING THE TECHNOLOGY OF THE 1960'S, A NATIONAL AIRSPACE SYSTEM WAS DEVELOPED WHICH ACHIEVED A RECORD OF SAFETY AND EFFICIENCY SECOND TO NONE.

NOW A GENERATION HAS PASSED, AND ANOTHER CHALLENGE LOOMS AHEAD. THE CONTINUED GROWTH OF AVIATION, BOTH IN NUMBERS AND SOPHISTICATION OF AIRCRAFT, IS THREATENING TO OVERTAKE THE CAPACITY OF TODAY'S NATIONAL AIRSPACE SYSTEM. AND AGAIN THE FAA IS MEETING THE CHALLENGE. IN ADDITION TO ONGOING OPERATIONAL ENHANCEMENTS, A NEW, HIGHER TECHNOLOGY NATIONAL AIRWAY SYSTEM IS UNDER DEVELOPMENT TO MEET THE DEMANDS OF THE FUTURE.

THE NEW SYSTEM, WHICH WAS AUTHORIZED BY THE AIRPORT AND AIRWAY IMPROVEMENT ACT OF 1982, IS BEING IMPLEMENTED IN ACCORDANCE WITH A CAREFULLY DEVELOPED NATIONAL AIRSPACE SYSTEM (NAS) PLAN.

THE MOVE TO ANOTHER GENERATION OF AIRSPACE SYSTEM TECHNOLOGY HAS BEEN ACCOMPANIED BY A RENEWED APPRECIATION FOR THE HUMAN RESOURCES OF THE FAA, FOR TECHNOLOGY ALONE CANNOT MEET THE CHALLENGES OF THE FUTURE. THE SYSTEM MUST BE OPERATED AND MANAGED BY PEOPLE - THE PEOPLE OF FAA."

THIS WAS A PREFACE QUOTED FROM THE NATIONAL AIRWAY SYSTEMS REPORT OF THE SECRETARY OF TRANSPORTATION TO THE UNITED STATES CONGRESS, "THE FAA AT 25, PEOPLE, PERFORMANCE, PROGRESS", PUBLISHED APRIL 1984. DO YOU AGREE WITH THIS QUOTE? I DO WITH THE EXCEPTION OF ONE SENTENCE. THAT BEING "AND AGAIN THE FAA IS MEETING THE CHALLENGE."

THE PROBLEMS WE FACE ARE MANY. I AM HERE TODAY TO GIVE YOU AN OPERATOR'S ANSWER TO THE QUESTION; "ARE WE ATTAINING THE MAXIMUM ADVANTAGE OF RNAV, STOL AND MLS AFFORDED US TODAY, IN SAFETY AND CONGESTION RELIEF, SEPERATELY OR AS COMBINED INTO FLIGHT NAVIGATION SYSTEMS?" I CAN TELL YOU SIMPLY: WE ARE NOT!

OUR PROBLEM IS WE SIMPLY ARE NOT MOVING FAST ENOUGH IN THE IMPLEMENTATION OF NEW PROCEDURES AND NEW TECHNOLOGY INTO OUR AIRWAYS SYSTEM. THE COMBINATION OF 3D RNAV, MLS AND STOL AIRCRAFT OFFER GREAT POTENTIAL TO IMPROVE OUR AIRPORT ACCESS PROBLEMS. WE HAVE FOR YEARS NOW BEEN DEMONSTRATING HOW EFFECTIVE OUR S.A.L.S. PROGRAM IS AT WASHINGTON NATIONAL AIRPORT BUT WE SEEMED BOGGED DOWN IN MOVING AHEAD WITH IMPLEMENTATION ELSEWHERE IN THE SYSTEM. WE NEED A CENTRAL PERSON OR OFFICE WITHIN THE F.A.A. WHO SPECIALIZES IN THE COORDINATION OF THESE PROJECTS AND WHO CAN EXPIDITE THE IMPLEMENTATION OF "SEPERATE AIRPORT ACCESS SYSTEMS" THROUGH THE ENTIRE ATC SYSTEM. THERE WERE OVER 100 RECOMMENDED IMPROVEMENTS, SOME WITH GREATER POTENTIAL THAN OTHERS, RECOMMENDED BY THE A.O.C.I. TASK FORCE OF WHICH I WAS A MEMBER. THE S.A.L.S. PROGRAM, JOINTLY DEVELOPED BY RANSOME - DE HAVILLAND - THE FAA AND OTHERS AND IS NOW IN OPERATION AT WASHINGTON NATIONAL AIRPORT, WAS ONE THAT WAS RECOMMENDED BECAUSE IT HAD VERY LITTLE, IF ANY, COST IMPACT TO THE TAXPAYER, HOWEVER COULD BE IMPLEMENTED VERY RAPIDLY.

BECAUSE WE DON'T HAVE A CENTRAL OFFICE TO WORK WITH, I CAN GIVE YOU SOME EXAMPLES OF WHAT OUR AIRLINES GOES THROUGH TO GET AN ENROUTE SEGMENT, ARRIVAL, OR AN APPROACH PROCEDURE APPROVED BY THE FAA.

WE HAVE DESIGNED RNAV ROUTES BETWEEN TWO HUB AIRPORTS APPROXIMATELY 100 MILES APART. THE ROUTE IS BASICALLY A STRAIGHT LINE THAT LEAVES ONE AIRPORT, CUTS ACROSS THE AIRSPACE OF A MAJOR MILITARY FACILITY AND TERMINATES IN THE AIRSPACE OF THE OTHER AIRPORT. IT DOESN'T INTERFERE WITH THE EXISTING AIRWAYS BECAUSE OF EITHER DESIGN DIFFERENCES OR ALTITUDE RESTRICTIONS. THE ENTIRE ROUTE WAS APPROVED BY EACH LOCAL ATC FACILITY BECAUSE OF THE LACK OF INTERFERENCE. IT TOOK EXACTLY SIX MONTHS FOR THIS ROUTE TO BE APPROVED BY THE REGIONAL OFFICE FOR IFR AUTHORIZATION. WHY?

THE ANSWER - FLIGHT CHECK!

WE HAVE DESIGNED APPROACHES TO CROSS RUNWAYS AT MAJOR TERMINALS THAT REQUIRE FLYING A STOL DEHAVILLAND DASH-7 TO THE EDGES OF ITS OPERATING ENVELOPE, AND EVEN THOUGH THE FAA DOESN'T HAVE AN AIRCRAFT THAT HAS THE REQUIRED MANEUVERABILITY OR PERFORMANCE RESPONSE, WE WILL WAIT FOR ANOTHER SIX MONTHS FOR FAA APPROVAL. AGAIN, AWAITING FLIGHT CHECK.

FLIGHT CHECKING A ROUTE THAT CAN BE SUPERIMPOSED ON A STANDARD IFR ENROUTE CHART APPEARS TO BE AN UNNECESSARY DELAY THAT CAN BE CORRECTED BY GOOD MANAGEMENT.

FLIGHT CHECKING AN APPROACH THAT WAS DESIGNED FOR AN AIRCRAFT WITH THE PERFORANCE CHARACTERISTICS OF A DEHAVILLAND DASH-7 WITH A SABERLINER OR JET COMMANDER NOT ONLY CAUSES UNNECESSARY DELAY BUT ALSO LEAVES OPEN QUESTIONS ABOUT WHAT DID WE LEARN BY SUCH CHECKS.

ALL AIRLINES REALIZE THAT THE FAA CAN'T OPERATE ALL TYPES OF AIRCRAFT, BUT WE SUBMIT THAT THEY CAN LEASE OR CONTRACT WITH THE OPERATORS OF HIGH PERFORMANCE OR SPECIFIC TYPES OF EQUIPMENT FOR ANY FLIGHT CHECKS THAT DEPEND ON MEETING STRINGENT PERFORMANCE CRITERION.

WE THE OPERATORS (WITH A VESTED INTEREST IN THE OUTCOME OF SAID "FLIGHT CHECKS") WILL UNDOUBTEDLY PROVIDE A SUITABLE AIRCRAFT MUCH SOONER THAN THE FAA CAN AND THE RESULTS WILL BE MUCH BETTER BECAUSE THE TEST WILL BE ACCOMPLISHED IN THE EQUIPMENT WE WERE TRYING TO PROVE IN THE FIRST PLACE.

THE LARGER PROBLEM IS ONE OF ACCEPTANCE OF THE NEW TECHNOLOGY BY THE PEOPLE OF THE FAA. THE FACT THAT AN AIRCRAFT CAN FIND ITS WAY TO THE END OF A RUNWAY (WITH NON-PRECISION MINIMA FOR RNAV ONLY AND PRECISION MINIMA FOR AN ARRIVAL THAT TIES INTO A MLS FACILITY) WITHOUT THE HELP OF INNUMERAL VECTORS TO FINAL BY A STRING OF ATC SPECIALISTS, IS JUST MORE THAN SOME CAN HANDLE.

ONE SCENARIO DEVELOPED LIKE THIS: INITIAL MEETINGS WERE HELD WITH THE FACILITY CHIEF AND HIS MANAGEMENT STAFF TO DISCUSS THE SALS CONCEPT AND HOW OUR RNAV, STOL, MLS EQUIPPED DASH-7'S COULD BRING THIS NEW TECHNOLOGY, AND ITS RESULTANT INCREASED ACCEPTANCE RATE, TO THEIR AIRPORT.

AFTER THE INITIAL DESIGN OF APPROACHES WERE STUDIED (JUNE 1983), THE FINAL DESIGNS WERE DRAFTED (DECEMBER 1983). NO FURTHER CONTACT WAS INITIATED BY THE AIRLINE BECAUSE OF PERSONNEL SHIFTS UNTIL JUNE 1984. THAT CONTACT WAS MADE WITH AN OFFER TO TEST FLY THE APPROACHES WITH ANY ATC STAFF MEMBER ON BOARD TO SEE HOW EFFECTIVE THEY WERE, AND TO FINALIZE ANY CHANGES THE FACILITY MANAGEMENT THOUGHT WERE NECESSARY.

THE RESPONSE TO THAT OFFER - "WELL, LET ME HAVE OUR PLANNING MANAGER GIVE YOU A CALL IN A COUPLE OF DAYS - MONDAY OR TUESDAY. BUT I DON'T SEE HOW THIS IS GOING TO WORK, IT'S JUST NOT GOING TO WORK HERE!"

AFTER AN APPROPRIATE WAIT FOR THE CALL WE INITIATED ANOTHER PHONE CONVERSATION TO THE FACILITY (42 DAYS LATER) AND INFORMED THE PLANNING MANAGER THAT WE HAD BEEN ASKED TO TESTIFY AT THESE HEARINGS AND THAT OUR PRIMARY COMMENTS WOULD CONCERN THE PROBLEMS THAT OPERATORS ARE HAVING INITIATING SALS PROCEDURES WHEN UTILIZING RNAV STOL MLS EQUIPPED AIRCRAFT.

HE RECALLED THAT WHEN EASTERN AIRLINES TRIED THEIR RNAV EQUIPMENT ABOUT 15 YEARS AGO, AN ELECTRA TURNED THE WRONG WAY AND HAD TO BE VECTORED BACK TO FINAL, "ALL AIRCRAFT REQUIRE VECTORS TO FINAL", "YOU CAN'T BE VECTORING THESE OTHER AIRCRAFT AROUND ONE THAT ISN'T. I DON'T WANT TO SOUND NEGATIVE ABOUT THIS, BUT I CAN'T BE GIVING RANSOME SPECIAL TREATMENT. WE HAVE OTHER COMMUTERS AND AIRLINES TO CONSIDER."

A LARGE PART OF THE RELUCTANCE OF ATC PERSONNEL TO ACCEPT THESE NEW CONCEPTS IS THEIR FEAR OF GIVING SOMEONE SPECIAL TREATMENT. WE DON'T WANT SPECIAL TREATMENT. WE DO, HOWEVER, WANT DIFFERENT TREATMENT. THE SALS CONCEPT IS BY DEFINITION DIFFERENT. WITH AIRCRAFT LINED UP FOR MILES FOR A PARTICULAR APPROACH TO A PARTICULAR RUNWAY, ANY SECOND LINE TO A SECOND RUNWAY, NOT CURRENTLY BEING USED, IS DIFFERENT.

THAT DOES NOT. IN OUR OPINION, QUALIFY AS SPECIAL HANDLING. IT'S NOT AN APPROACH FOR RANSOME AIRLINES ONLY, IT'S FOR ANYONE WITH THE REQUIRED EQUIPMENT. IT IS THE WHOLE REASON FOR THE SALS CONCEPT AND BELIEVE IT, IT IS GOOD FOR EVERYONE IN THE SYSTEM. BY NOT JOINING THE LONG LINES FOR THE LONG RUNWAYS WE OPEN A SLOT FOR THAT RUNWAY THAT SOMEONE ELSE CAN UTILIZE.

AT WASHINGTON NATIONAL WE'RE NOT SPECIAL, BUT WE ARE DIFFERENT. WE STILL COME IN AND LAND ON THE SAME RUNWAYS, WE JUST WORK IN DIFFERENTLY. WE DON'T HAVE TO GO 20 MILES DOWN LINE TO GET IN LINE ON THE ILS. WE CAN MAKE A QUICK TURN IN AND COME IN ON THE RNAV TO 21 OR THE RNAV MLS TO RW 33.

MAYBE IT IS SPECIAL, ATC IS NOT GIVING US A FAVOR, IT'S NOT LIKE WE'RE GETTING OUT OF LINE, WE'RE SAYING ANYBODY THAT HAS THE EQUIPMENT CAN DO IT. IT'S HELPING ATC, IT'S MAKING A HOLE ON THAT ILS THAT DOESN'T HAVE US IN IT. THERE'S A HOLE IN THERE FOR SOMEBODY ELSE TO USE NOW. WE COME IN ON THE RNAV APPROACH - MAYBE THAT IS SPECIAL - BUT IT IS DIFFERENT, AND IF YOU'RE DIFFERENT ENOUGH TO BE ABLE TO DO IT, THEN YOU SHOULD BE ABLE TO BE SPECIAL. IT'S NOT PRIORITY, IT'S SEPERATE. IT'S GOOD FOR ATC, IT'S GOOD FOR US, IT'S GOOD FOR THE GUY IN THAT LINE WHO TOOK OUR SLOT AND IS 5 MILES AHEAD OF WHERE HE SHOULD HAVE BEEN. THIS IS NOT ONLY HELPING RANSOME AIRLINES, IT'S HELPING THE WHOLE SYSTEM. THAT'S THE WHOLE IDEA BEHIND SALS, TO SHED SOME OF THE BURDEN FROM ATC, FOR TRAFFIC TO RUN SMOOTHER, TO USE ALL THE AVAILABLE AIRSPACE TO ITS FULLEST POTENTIAL AND MAKE FOR A MORE EFFICIENT AVIATION SYSTEM. EVERYBODY IN THE INDUSTRY WANTS THIS TO HAPPEN, EVERYBODY IN THE INDUSTRY NEEDS MORE ACCESS, EVERYBODY IN THE INDUSTRY DEMANDS IT AND WE HAVE A SPECIAL WAY TO DO IT! BUT IT'S NOT JUST HELPING US, IT'S HELPING EVERYBODY.

THIS TECHNOLOGY IS HERE TODAY AND IT IS NOT BEING UTILIZED. IT'S UP TO THE FAA AND ITS PEOPLE TO MOVE, MOVE WITH THE TECHNOLOGY AVAILABLE TO US, TOWARDS A SAFE, BUT MORE EXPEDIENT ACCESS TO OUR AIRPORTS.

LET'S LOOK AT WASHINGTON NATIONAL AIRPORT TO SEE HOW IT CAN WORK. HARRY HUBBARD AND HIS STAFF, WHO DEDICATED TOTAL COOPERATION TO THE CONCEPT OR WE STILL WOULDN'T KNOW IF THE ENTIRE CONCEPT OF RNAV/MLS/STOL AND SALS WAS WORKABLE. WITH THE COOPERATION OF THE LOCAL ATC, THE REGIONAL OFFICER, OUR PRINCIPAL OPERATIONS INSPECTOR AND THE ENTIRE LOCAL FAA, THE CONCEPT IS NOT ONLY WORKING, BUT IS DESIRABLE AND HAS IMPRESSED WASHINGTON NATIONAL AIRPORT CONTROLLERS. MR. HUBBARD, THE FACILITY CHIEF AT DCA, HAS BEEN QUOTED AS SAYING "THAT IN 4½ YEARS, SINCE THE ARRIVAL OF THE DASH-7 AND OUR AGREEMENT WITH RANSOME AIRLINES, THERE HAS NEVER BEEN ONE TIME THAT A RANSOME FLIGHT HAS EVER COME CLOSE TO ENCROACHING THE INTERSECTION OF THE MAJOR RUNWAY." THE ONLY REASON IT WORKED WAS BECAUSE OF THE PEOPLE IN THE FAA, THEY WORKED AT IT. THEY WENT OUT OF THEIR WAY TO CHANGE THINGS. WE HAD INITIAL MEETINGS WITH THE FACILITY CHIEF AND HIS STAFF AND THEY RECOMMENDED WE HOLD THESE SAME MEETINGS WITH ALL HIS PEOPLE. WE WENT DOWN AND WITH US WE BROUGHT DIAGRAMS AND PERFORMANCE DATA, WE SHOWED THE CONTROLLERS THAT THESE AIRCRAFT WOULD DO WHAT WE CLAIMED, WE EVEN WENT UP ON DEMONSTRATION FLIGHTS TO SHOW THEM FIRST HAND. WE HAVE HAD A LONG RELATIONSHIP WITH THE WASHINGTON FACILITY APPROACH, WITH VARIOUS TYPES OF AIRCRAFT, AND THEY KNEW THAT OUR PILOTS WANTED TO GET IN QUICKER, AND THEY KNEW THEY WANTED TO GET US OUT OF THE LINE, AND THEY CHANGED THEIR THINKING. WHEN WE WENT TO WASHINGTON NATIONAL AIRPORT, ON THE FIRST FEW SIMULTANEOUS LANDINGS, AND AIR CARRIER PILOTS WERE UNHAPPY, RELUCTANT TO ACCEPT US, EVEN THOUGH THE FAA AND THE LOCAL ATC PEOPLE HAD. ONLY BECAUSE OF THE CONFIDENCE OF THE FAA, ATC PEOPLE IN OUR AIRPLANES, OUR PILOTS AND OUR CONCEPT, THEY KNEW IT WOULD WORK. IT HAS NOW BEEN TOTALLY ACCEPTED BY ALL CARRIERS. THEY NOW KNOW THAT IT WORKS AND ARE HAPPY FOR THE EXTRA SLOTS IN THE APPROACH.

WITH THIS TYPE OF COOPERATION, THESE SAME RESULTS CAN HAPPEN AT ANY AIRPORT IN THIS COUNTRY, BUT ONLY WITH THAT TYPE OF COOPERATION.

WHAT THE FAA NEEDS IS A PLACE WHERE ONE CAN GO, AN RNAV/MLS/SALS TYPE OFFICE IN THE FAA AT THE REGIONAL LEVEL, SO WE CAN GET THESE PROJECTS THROUGH WITH SOME ENTHUSIASM AND WITH SOME COOPERATION AT THE REGIONAL LEVEL. WE NEED A "CZAR" OF SALS. WE NEED SOMEBODY IN FAA WHOSE JOB IS TO MAKE SEPERATE ACCESS A PRIORITY, NOT AN ASSIDE PROJECT.

SUMMING UP, RNAV/MLS/STOL AND THE SALS CONCEPT IS NOT BEING UTILIZED TO ITS FULLEST POTENTIAL, NOT BECAUSE THE TECHNOLOGY IS NOT THERE, IT IS, BUT BECAUSE MANY IN THE FAA ARE STILL OPERATING IN THE PAST.

THE FAA MISSION IS, AND I QUOTE, "SERVICE TO THE NATION BY PROVIDING A SAFE AND EFFICIENT AVIATION SYSTEM WHICH CONTRIBUTES TO NATIONAL SECURITY AND THE PROMOTION OF U.S. AVIATION." SOME OF THE FAA VALES ARE "QUALITY OF SERVICE, EXCELLENCE OF TOTAL WORKFORCE, SUSTAINED MOMENTUM, CONCERN FOR PEOPLE, CREATIVITY." THE FIRST 4 (FOUR) OF THE FAA GOALS IS "(1) ENHANCE U.S. AVIATION SAFETY, (2) BUILD AN FAA CULTURE WHICH NURTURES ACHIEVEMENT OF PEOPLE'S ASPIRATIONS AND PROVIDES A MANAGEMENT PROCESS FOR REALIZING INDIVIDUAL, AS WELL AS ORGANIZATIONAL OBJECTIVES, (3) DEVELOP, REFINE AND IMPLEMENT FAA PROGRAMS AND LONG RANGE PLANS, AND (4) ASSURE EFFECTIVE AND EFFICIENT UTILIZATION OF HUMAN, FISCAL, MATERIAL AND AIRSPACE/AIRPORTS RESOURCES."

EACH DAY WE FALL FURTHER BEHIND. WE HAVE A SERIOUS AIR TRAFFIC DELAY AND AIRPORT ACCESS PROBLEM AND IT IS GETTING WORSE EVERYDAY. WE MUST USE EVERY MEANS WE HAVE TO INCREASE THE AIRCRAFT ACCEPTANCE RATE AT OUR NATION'S MAJOR AIRPORTS. WE ARE CONVINCED WE CAN DO THIS SAFELY AND EXPEDITIOUSLY IF ONLY WE CAN IMPLEMENT THE PROGRAMS WE HAVE AT NATIONAL ELSEWHERE IN THE SYSTEM. IT HAS BEEN SAID, AND I TRULY BELIEVE IT, "THERE HAS BEEN MORE TECHNOLOGICAL ADVANCE OVER THE PAST DECADE THAN IN ALL MANKIND PREVIOUS". OUR PROBLEM IS GETTING THIS TECHNOLOGY IN OPERATIONAL REALITY. WE JUST AREN'T MOVING FAST ENOUGH. SOMETIMES I FEEL WE ARE NOT PROGRESSING AT ALL.

THANK YOU, MR. CHAIRMAN, FOR THIS OPPORTUNITY TO EXPRESS OUR VIEWS. I AND MY STAFF WILL BE GLAD TO ANSWER ANY QUESTIONS YOU OR THE COMMITTEE MIGHT HAVE.

BIOGRAPHICAL SKETCH: J. DAWSON RANSOME

J. Dawson Ransome is Chairman and President of Ransome Airlines, a Philadelphia based commuter service. Ransome Airlines' has over 150 scheduled jet-prop departures a day in thirteen markets between Washington, D. C. and Boston, Massachusetts. The airline began operation in March of 1967, became an Allegheny Commuter in August of 1970, and as of September, 1979 was the largest commuter airline in the world. On June 1, 1982, the Airline broke its twelve year association with the Allegheny Commuter System and began to market its services under its own name.

Dawson Ransome is also Vice President of Giles & Ransome, Inc., a 66 year old construction equipment dealership representing the Caterpillar Tractor Co. in the Greater Delaware and Lehigh Valley areas.

Mr. GLICKMAN. Thank you.

I just have one comment before I turn it over to my colleagues. Mr. O'Brien, United Airlines allows passengers to listen to transmissions between either controllers in the tower or when you're on the ground, and during my last two trips through Chicago O'Hare, in listening to transmissions and watching outside the plane, it's just so obvious to me that we have just—the carriers have just oversaturated the airports during certain key times, and in fact, during one conversation, we couldn't get into our gate because there were nine planes pulling out at the exact same time. We were in the box for 45 minutes and the—and the guy on the ground who is giving the information to the pilots says, "If you'd just come in an hour later, there's nobody leaving; nobody taking off, you know. You're all leaving at 6:44." And that's what's happening here.

Well, it just strikes me that in light of the new technology, which I think we have to have, and I think Mr. Ransome is right to try to push this technology into a feasible form, I see what your pilots have to go through and what carriers have to go through, but some of it is the carriers' own fault. They have overscheduled their airplanes and the people in the planes are blaming somebody.

Mr. McCandless talked about—I mean, it is just so very, very frustrating, and I just think that as a part of this—whether it's landing systems or whether it's RNAV or whether it's new ways of using runways, we also have to use good judgment. There are certain laws of physics that can't be broken by new technology, and one is that you can't have more than two airplanes taking off at the exact same point, exact same time. Nor can you have them leaving the exact same gate, exact same time.

I just think that has to be part of the solution as well. The carriers have to be responsible as part of this solution. And in this period of deregulation, I know it's impossible. Everybody wants on one-up the next carrier and they all—I see at O'Hare, American is expanding at O'Hare because they want to compete with United and, you know, problems just—it gets frustrating for me, somebody who has to fly back to Kansas. I have to go through one of these airports that's—these hub airports that I just keep running into this problem all the time, and not all of it is (solvable by) a technical solution, I guess my point is. Some of it is a judgmental solution and somebody's got to make some of these judgments and maybe our antitrust laws don't permit the carriers to get together and talk about these things as they should, but it's a very serious problem that partially is not related to technology.

Yes.

Mr. O'BRIEN. I'd like to make one comment on that. I agree with basically what you're saying. There's scheduling problems, and the scheduling problems come as a direct result of total airport capacity and the desire of the traveling public to go at certain times, but if you look at the hub and spoke systems—and you have 44 flights scheduled at 6 in the evening, for example—obviously, all 44 of those flights don't go in at 6. They go between 6 and 7 and you have 44 departures that leave between 6 and 7 because not everybody can get on the airport at the same time.

So for running the hub-and-spoke system, they say 6 is your arrival time, but then, from a practical point of view, everyone knows that it's spread between 6 and 7. There's so many slots you can get in and out of there between that time period.

Mr. GLICKMAN. The passengers don't know that.

Mr. O'BRIEN. Right. You're right. There's a scheduled time that's posted, but from a practical point of view, the system doesn't quite operate that way. What has really happened is the system at certain airports, especially in the northeast part of this country, has reached maximum capacity. You just cannot get any more aircraft into those airports in a given amount of time. So the airlines know this; the FAA knows this, and no matter what the schedule says, it is spread out fairly well over the hours, all those delays—whether you are coming in at 6:15 or 6:45, you're still going to have delays and there are still going to be airports that are congested. You don't come into O'Hare and find nobody operating at 7:15 because they all left at 7. The airport is operating at maximum capacity continuously.

Mr. GLICKMAN. Yeah, well, I guess my point is that this is another side of the equation that has to be taken into account.

Mr. McCandless.

Mr. MCCANDLESS. Are we passing over my colleague who got up late this morning?

Mr. GLICKMAN. Well, I—I'm just——

Mr. MCCANDLESS. Thinking, yes.

Mr. GLICKMAN [continuing]. Providing this just like the carriers do, in order of schedule. You were here first. [Laughter.]

Mr. MCCANDLESS. I'd like to go back and be regional again, if I may, LAX. Besides the international and the national, you have the commuters, the Cessnas and the Pipers and then you have the intrastate type of operation, BSA, Air California, et cetera.

We talk about utilization of these runways in a manner that Mr. Sandford was explaining. There really aren't—I guess the question I would have of Mr. Ransome, because he mentioned this in his comments, how could we take a situation like LAX for purposes of our discussion here and increase its capacity when a great deal of the commuting in California is intrastate and done with 9's, 727's, 37's and large aircraft that are not any different than those that travel in from other areas?

Mr. RANSOME. I'm not sure I can answer how that could be done if you are confined to that type of aircraft. I think that the construction of reliever runways, however, will move traffic off of those. You won't be competing the general aviation, our industry and others if we can get reliever-type runways which could be overlaid on taxiways. There's all kinds of ways that that could be done which would substantially improve the acceptance rate of the airport for those type of aircraft.

That is the answer. Today, everybody is competing for the one runway that was designed for that type of aircraft and you're competing with aircraft that don't need that. So that's about the only solution I can see to it.

In the East, which I'm a little bit more familiar with, for an example, we have—our proposal to the FAA is to operate in the crosswind runways at JFK in New York. We have no problem with

that. We can do it extremely well, whether we use a stub or any portion thereof. That's another way of taking a look at removing ourselves from the major carriers.

I think if—to be very frank—that the whole lower segment of the—of the ATC system needs to be restudied—not restudied, but reconfigured, and I think this is possible to allow us, those of us who have invested in the technology, to use it.

Mr. McCANDLESS. We're back to a situation that I experienced with the chairman. These older configuration planes, it would appear to me, are going to be around for quite some time, based upon the fact that in negotiating with one airline to be replaced by another in my previous life, they said they could buy a used DC9,s cheaper than they could purchase, say, a 20- or a 30-passenger, 15-passenger for this particular flight, and therefore, the expense of continuing that flight was very doubtful, which comes back, then, to this type of plane which is going to continually be used until such time as is used up, that is, one airline I've traveled on most of my life started out with DC3's and voila, we got Fairchilds and we thought we were really in high clover.

Mr. RANSOME. Uh-huh.

Mr. McCANDLESS. And it's progressed up since then. Now, it's successor has Metroliners, we would call them.

Mr. RANSOME. Uh-huh.

Mr. McCANDLESS. So we're not talking, then, if I understand the situation, about just navigational and flight systems. It would depend, also, upon the location, and if the location is not—cannot be addressed by this, then we're talking about additional concrete. Is that what we're saying? That is, LAX, maybe, because you don't have the cross runways and so forth?

Mr. RANSOME. Yeah, I would say that you need some additional concrete and I—I feel that that can be done in many, many airports and it exists today in many airports in the form of acceptable taxiways that would be—would be very adequate for general aviation of our industry and not just for our STOL aircraft but a very substantial cross-section of general aviation and business aircraft and so forth.

Mr. McCANDLESS. If I may, Mr. O'Brien, I'd like to ask this question: The traffic at LAX has a considerable amount of international flavor to it. Is there perceived to be a slow-up in the—in the international flights based upon possibly anything in the way of a longer time for language translations, meaning simply a positive understanding of what someone is saying because of accent or something? Is that any kind of a role in the overall aspect of this part we're talking about?

Mr. O'BRIEN. There are occasional incidents of misunderstanding and clarification, retransmissions, but the number of incidents like that are so small that it's just a ripple on the—in the bigger problem of capacity at LAX. I'd like to just acknowledge something that Mr. Ransome here has said. You could take his technique that you have here at National—not intersecting runway technique, but if you did put in another short runway, at LAX, I'm not sure you could use the taxiways there because they're pretty capacity-limited as well getting to those four parallels, but if you did put in a STOL runway and it was very close—it would have to be very close

to the other runways because there just isn't that much real estate available at Los Angeles to expand either north or south, but then you're back to the problem of closely spaced parallel runway operations which was addressed in this task force report we talked to earlier, and there are recommendations to use those techniques today. That's something that could be done in the near term. It's not something that we have to wait 5 or 6 years for. It's not some big part of the national airspace system plan program. It's something that could be done today.

So there are incremental improvements that could be made. For example, if 15 percent of all traffic going into LAX were STOL type or equivalent to STOL type aircraft, and you remove those airplanes from the four main parallel runways and put them on this short STOL strip, then you do have increased capacity for the old DC9's that some operator wants to buy. There are STOL airplanes operating into LAX today, and if there was a unique facility for those aircraft, you do then increase capacity on the other runways for the old conventional type airplanes.

Mr. McCANDLESS. Having not traveled extensively throughout the United States, is LAX unique in its configuration, because we've talked cross runways along the east coast and, of course, St. Louis and Chicago and a number of others are cross runways.

Mr. O'BRIEN. LAX is——

Mr. McCANDLESS. That's more adaptable to what it is that you're talking about. So are STOL——

Mr. O'BRIEN. LAX is not unique. There are—parallel runways at almost all major airports today. Atlanta is quite similar to Los Angeles in that you have three main parallel runways. You have four at Los Angeles, but the problems that crop at Los Angeles and the solutions to those problems aren't unique. They are addressed by some of the recommendations in this task force report.

Mr. McCANDLESS. Thank you.

Thank you, Mr. Chairman.

Mr. GLICKMAN. Mr. Carney.

Mr. CARNEY. Mr. Chairman, I'd like to thank all the panelists. It was very informative. I'd also like to congratulate Mr. Warner for courage and say to him that it seems to me that it's obvious that the systems will be in place and they'll be continuing to go in place. You indicated in your testimony that airports that wish to put ILS's in have been denied and then, obviously, with the program that is there, is that they'll have an MLS system in the future.

How can we accommodate your people under those circumstances? I mean, I fully understand your frustration and fully understand your testimony and how important it is to those you represent, but I don't think we're going to reverse the tide. Now, how can we work with your people to help alleviate some of the problems associated with the changes?

Mr. WARNER. Mr. Carney, this is not meant to be a sarcastic answer, but we would suggest they be put on somebody else's airport. We suggest that the MLS technology that's been developed be utilized for that which it will add an incremental advantage and where it is cost effective. You've heard many witnesses speak to those advanages and specialized applications, including MLS use

for increasing capacity at the few airports in the country. I would emphasize that there are, indeed, only a few airports in the United States that have current capacity problems. There is applicability there.

Mr. Ransome has indicated the amount of money that his single company has invested to use that advancing technology. Others will follow suit, I'm sure. Fine. They've made an economic decision; it's providing a service to individuals who are interested in flying along those routes, and we would not have any objections to MLS technology being used in that manner.

Our concern is that we see something just over the horizon—in fact, it's, indeed, above the horizon at this point, that may be able to provide a multipurpose communication, navigation, search and rescue, and approach capability. That is satellite technology. The way is being paved very quickly. Not to endorse one system over another, but I had the opportunity this morning at National Airport, where I arrived for this hearing, to cross paths with Dr. O'Neill, who's the developer of the Geostar system, and he indicated that next week in the Federal Register, we'll see an NPRM paving the way for the frequencies that are necessary for that private system to be put in place.

The fact is that very low cost equipment that can be multipurpose will soon be with us. We believe that many more general aviation aircraft owners are going to invest in this type equipment which may only be 3, 4, and 5 years away—still within the MLS implementation schedule than they are going to invest in MLS, even if the price were to come down to $5,000 for an airborne unit. It's a single-purpose piece of equipment. It's only used for the last 5 or 6 miles of landing under inclement weather and it's an economic judgment, as it is with any piece of equipment that isn't mandated as to whether an owner's going to put it in.

Commuters and jet operators have said they're going to put it in. Fine. I'm suggesting that the vast majority of users of the air traffic control system will not see a need and they'll make a negative economic decision.

Mr. CARNEY. Thank you.

I would just like to comment on Mr. Ransome's opening comment. It could be worse. Your name could be Dawson Hijack. [Laughter.]

And I yield back to the Chair.

Mr. GLICKMAN. Mr. Cooke, how do you respond to Mr. Warner's comment?

Mr. COOKE. Well, quite simply, the better is always the enemy of the good. In 1970, I would have forecast MLS is going to be here in 3 to 5 years. It seemed that way. It's taking longer. We made the decision some time ago that for precision approach aids, it's MLS or it's nothing, and in our view, the MLS provides an incredible capacity, capability over no approach aid whatsoever, so we strongly urge development of the MLS program.

We've reviewed the FAA's implementation scheme, made recommendations to change it to provide for proliferation, if you will, of precision approach aids throughout the country, and we feel MLS is the aid of the day. Not tomorrow, not yesterday.

Mr. GLICKMAN. What about to the small airplanes, you know? I guess the question implicit in Mr. Warner's statement is the affordability. I mean, that's really the key. How do you deal with an issue of——

Mr. COOKE. I would bounce that issue to Mr. Quinby, if I may, because I believe he specifically addressed it in his remarks.

Mr. QUINBY. Thank you, Bob.

Mr. Chairman, I respectfully disagree with the future of MLS as suggested by Bob Warner. I consider myself a loyal minority member of AOPA on this issue. [Laughter.]

Mr. CARNEY. He covered all the bases there, didn't he? [Laughter.]

Mr. QUINBY. I would like to suggest to Mr. Warner that if he continues with this approach, it will be a self-fulfilling prophesy until the members of OAPA, in their single-engine, piston-powered, instrument-qualified airplanes begin to see the benefit for installation of MLS receivers, processors, range measurers, area navigation that will give them an operating advantage that they need over not having it, or having—being limited to ILS.

I have enough faith in the qualifications of the MLS signal that that will take place. How long it will be before the AOPA members are offered an MLS receiver to give them a benefit and a price that they can afford, that I cannot guess. It depends on the kinds of things that we're trying to do today.

Mr. GLICKMAN. OK. We thank you, gentlemen, all, for your testimony. Very excellent testimony. Very interesting. Appreciate it.

Our last witness is Mr. John Kern, Deputy Director of the FAA Office of Flight Operations.

Mr. Kern, your entire statement will appear in the record. If you want to respond to what you heard, I assure you that everything you've got in your testimony will be in the record, so you need not repeat it all.

Mr. KERN. I understand, Mr. Chairman. [Laughter.]

Mr. GLICKMAN. But there were a lot of things said here today that may be worthwhile to the FAA to respond to. Frankly, you—I think you've got through the hearings with far fewer number of criticisms that I might have expected earlier in the day, which I think is a compliment to you all.

Mr. KERN. Yes, sir.

STATEMENT OF JOHN KERN, DEPUTY DIRECTOR, OFFICE OF FLIGHT OPERATIONS, FEDERAL AVIATION ADMINISTRATION, ACCOMPANIED BY MARTY POZESKY, DIRECTOR OF THE PROGRAM MAINTENANCE AND ENGINEERING SERVICE, AND WILL REAZIN, MANAGER OF THE AIR TRAFFIC PROCEDURES DIVISION, AIR TRAFFIC SERVICE

Mr. KERN. Thank you, Mr. Chairman.

As you mentioned, I'm John Kern, the FAA's Deputy Director of the Office of Flight Operations, and with me today are Marty Pozesky, Director of the Program Maintenance and Engineering Service; and Will Reazin, Manager of the Air Traffic Procedures Division, Air Traffic Service.

I will summarize my statement. Before I begin, though, I do know the chairman's interest in aviation safety and approach procedures and matters of that nature. Last time I appeared before you, I was with Mr. DelBalzo, from our eastern region, and we talked about the improvements we made recently to our northwest approaches to National Airport. I am happy to say that they have been implemented and they're commissioned, flight-checked, and operational as of the 19th of this month.

I'll go through quickly some of the highlights of my testimony. I think one of the things that may be confusing to the members of the committee and some of the people in the audience FAA's use of terms like "short takeoff and landing" and "steep approach" and "departure criteria" and "stub runway operations." I think the operation at National Airport probably highlights that confusion because we do have an aircraft that, in fact, has been certified officially by our airworthiness standards, the DHC7, as a steep approach and departure aircraft, a STOL aircraft.

About 10 or 15 years ago, we had a number of aircraft that were also classified as STOL aircraft, but that did not mean that they were capable of the same kinds of procedural maneuvers that the DHC7 was. They simply could land on short pieces of runway and depart on those same kinds of runways.

Another thing that I wanted to clear up is the term "stub runway operation." Basically, it's where the FAA, air traffic and others utilize a piece of a runway that otherwise would not be utilized. I think it's safe to say that in the vast majority of airports in the country, we've been using stub runway operations for years and years and years with all kinds of aircraft.

As a pilot, and many others here in the room will testify to this, it's not uncommon that an aircraft is asked on short final or on final approach to stop short and hold short of a runway. In effect, that could be called a stub runway operation. Here at National Airport, we happen to be doing it with a particularly certified aircraft, navigation aids that support a unique approach and operational procedures that also support that approach.

I did want to mention that the FAA, over the past few years, working with industry, has developed air worthiness standards, airport standards, and terminal instrument procedures that do support the kind of operations you're talking about today. In fact, we've worked closely with Mr. Ransome and his team and others in this room.

In fact, we've given Mr. Ransome, I believe, an exemption from the slot criteria at National Airport to operate his two extra flights an hour that we operate now presently in and out of National Airport.

We have an intense program in the FAA in the area of TERPS development—Terminal Instrument Procedures—particularly in the area of the microwave landing system. It began quite some time ago and should terminate prior to the installation of the first federally funded MLS in early 1986.

I think we've testified before sufficiently about the MLS program. We do plan to buy approximately 1,250 of these systems to equip 1,250 runway ends in the United States. I think it's signifi-

cant that we will be providing that kind of a precision service at now 1,250 runway ends, where at present, we have about 800.

As I mentioned, we have an intensive TERPS and operational development program. We do intend to be ready for the users when the systems are installed. We're working closely with several States right now: Michigan and Alaska, in particular, on non-Federal systems that are installed and are commissioned and will be used soon.

Let me just say a little bit about the RNAV situation. FAA has worked closely with the users over the years, of course, and there are a number of RNAV systems that are out there and being used today. There are probably thousands of RNAV systems in aircraft. They are used for transoceanic flight; they are used for enroute navigation here in the United States by all segments of the aviation community. In fact, we now have about 347 commissioned operational RNAV procedures in the United States. Public use procedures.

Let me just end by saying it's clear that STOL and MLS and RNAV can all play a role in increasing the future capacity of our Nation's existing airport structure, but they do not represent a panacea that will solve the future capacity problems. We must continue to develop and refine our ATC procedures and technology, and importantly, to foster and develop additional runway capacity.

Mr. Chairman, that summarizes my statement. We're ready for your questions at this point.

[The prepared statement of Mr. Kern follows:]

STATEMENT OF JOHN KERN, DEPUTY DIRECTOR OF FLIGHT OPERATIONS, FEDERAL AVIATION ADMINISTRATION, BEFORE THE HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY, SUBCOMMITTEE ON TRANSPORTATION, AVIATION, AND MATERIALS, CONCERNING AREA NAVIGATION, STOL AIRCRAFT, AND MICROWAVE LANDING SYSTEMS. JULY 24, 1984.

Mr. Chairman and Members of the Subcommittee:

I am John Kern, FAA's Deputy Director of Flight Operations. With me today are Marty Pozesky, Director of the Program Maintenance and Engineering Service, and Will Reazin, Manager of the Air Traffic Procedures Division. We are pleased to appear before you to discuss area navigation systems (RNAV), Short Takeoff and Landing (STOL) operations, and Microwave Landing Systems (MLS).

The FAA has had a long involvement with the subject of STOL operations. In fact, as far back as 1961, the FAA published the second report of Project Hummingbird which examined the possibility of producing steep-gradient aircraft with vertical and short takeoff and landing (V/STOL) characteristics. That report concluded that present technology could produce STOL aircraft but that development would depend largely upon a more extensive use of low altitude terminal area airspace and close-in and in-town small size landing areas.

Before going further, let me define what it is we mean by a STOL aircraft. A STOL aircraft is an aircraft with a certified

performance capability to execute approaches along a glide slope of 6 degrees or steeper and to execute missed approaches at a climb gradient sufficient to clear a 15:1 missed approach surface at sea level. By that, I mean for every fifteen feet of horizontal distance on a missed approach, a STOL aircraft must be able to climb sufficiently to clear an object an additional foot in height. A STOL runway is one which is specifically designated and marked for STOL aircraft operations, and designed and maintained to specified standards.

Following the Project Hummingbird report in 1961, the FAA has continued work on STOL operations. Operational evaluations have been conducted of several different aircraft during this time, and a variety of efforts undertaken to define appropriate standards for STOL operations. Thus far, however, only one aircraft has been certificated in the U.S. for STOL operations, and that is the DeHavilland DHC-7 (referred to as the Dash 7) which was certificated for STOL operations in 1973. Since October 1983, Ransome Airlines has been authorized to conduct RNAV/MLS/STOL operations into Washington National Airport using the Dash 7. An MLS/STOL runway approach has also been in effect at Valdez, Alaska, since October 1982.

We have in progress a new STOL test program to develop Terminal Approach Procedures (TERPS) data using the new MLS. This

program was developed cooperatively by DeHavilland, Transport Canada, and the FAA. We will be using a Dash 7 aircraft for the test, and will be executing straight-in and offset approach courses as well as different approach angles up to 8 degrees to develop appropriate data. The program also calls for developing data on missed approaches. We will also assess a variety of other terminal manuevering procedures: STOL MLS departures--both straight out and offset, MLS turn reversals based on MLS guidance and Precision Distance Measuring Equipment, and MLS shuttle patterns. Our preliminary system check out flight test is scheduled for this fall, and our data collection flights will be run next Spring. Data processing is scheduled for Summer of 1985, with analysis of that data being completed by October 1985. We expect to have draft TERPS criteria developed by January 1986.

During the early years of development of STOL, the emphasis was placed on operation of the aircraft from city center to city center. Today, it appears that STOL shows more promise in its ability to augment the existing airspace at present airports, permitting increased utilization of these airports as demands on the present system increase.

I would like to take a few minutes now to bring you up to date on our MLS program. In January of this year a contract was

awarded to the Hazeltine Corporation for the production of the first 208 MLS's. This award culminates several years of extensive research and development by both national and international organizations and signals a new era in precision landing systems.

In the United States, it is envisioned that 1250 Microwave Landing Systems will be in operation by the year 2000. The MLS implementation program will take advantage of the increased reliability of digital electronics systems together with the reduced costs of those systems to provide the capability for all weather service at most MLS equipped airports. Designed to minimize the economic impact to the users of the system as well as protect the FAA's capital investment, the transition from ILS to MLS will be gradual. This will be accomplished by installing the first systems in networks to maximize user benefits. These networks are organized for the most part around major hub airports along flight routes of commuter operations in order to provide expeditious service to all the users. Some initial collocations (ILS alongside MLS) will be necessary. These joint installations are expected to coexist for several years, permitting a sensible time period for airborne equippage by the aviation community.

Beginning in early 1986, the 208 systems of the Hazeltine contract will be installed over a 3-year period. In addition

to producing the MLS, the contractor will be responsible for providing site preparation and survey, installation and equipment checkout, preliminary flight inspection and engineering support. Included in the contract is an option for training. Another key feature that will be provided is a Reprocurement Data Package (RDP) which is intended to facilitate the final two MLS procurements by standardizing designs and equipment configurations. The RDP will provide comprehensive design specifications and technical schematic diagrams that will assure standard components and elements for full MLS hardware. This will ensure benefits in operating and maintaining the system as well as training the essential technicians to reduce the life cycle costs. This commonality of design and equipment is consistent with the major theme of the NAS Plan and is in concert with the FAA's 1980's maintenance concept.

While all MLS's will have standardized features, six antenna options are available which will permit each system to be tailored to particular operational requirements, multipath environment, and runway length. The flexibility of these antenna options allows individual airport operators and the users to satisfy the precise operational need of their respective airports and aircraft.

Of considerable interest but not part of the MLS contract is the issue of MLS avionics development and availability. In

this area the Radio Technical Commission for Aeronautics (RTCA) has two special committees charged with the responsibility of preparing minimum operational performance standards (MOPS) for precision DME and RNAV avionics. These essential avionics standards will be available well in advance of industry/user requirements to assure quality receivers are available at moderate costs to the operators. In addition, Aeronautical Radio, Inc. (ARINC) which develops Technical Standard Orders (TSO's) for avionics equipment is mounting an effort to provide these important standards for air carrier designs. Currently, there are two manufacturers producing commercial grade receivers in a price range of $8,000-$10,000. It is anticipated that general aviation avionics will cost $2,000 each when equipment is mass produced. Naturally, the greatest impetus for MLS avionics availability will be the deployment of ground systems and demonstrated benefits to the users.

An on-going program intended to demonstrate these benefits is the FAA Service Test and Evaluation Program (STEP). The STEP program utilizes prototype hardware derived from the early R&D effort. These systems are installed at a number of sites including Washington National Airport, and Clarksburg, West Virginia. Agreements were reached with Ransome and Wright (previously Aeromech) Airlines who conducted regularly scheduled commercial operations among these locations. In

exchange for the benefits to these users, the FAA obtained essential feedback on operational systems.

Essentially, the STEP program was designed to facilitate the transition from R&D to operations by providing real world experience. The program has worked well in this regard.

As implementation of MLS nears, other demonstration programs have been initiated by the FAA to provide the users with necessary procedural information and operational experience.

In this regard, the Flight Inspection and Terminal Approach Procedures Program (FI/TERPS) is intended to develop the criteria (procedures, standards and tolerances) needed in the operational phase when systems are commissioned in January 1986. The program is diverse in scope, including 28 individual projects for aircraft of differing flight characteristics and different flight procedures varying in complexity from standard straight-in approaches to segmented and curved approaches. Criteria are also being developed for departures and missed approaches as well as for special landing environments including those for helicopters.

Supporting the FI/TERPS program is the National Prototype Demonstration Heliport Program. This program is dedicated specifically to testing various applications of MLS and

rotorcraft to develop standards and criteria and evaluate new technologies. The FAA Administrator has selected four communities to participate in these evaluations. Operational MLS systems will be installed and tested at the following heliports: Indianapolis, Indiana; Los Angeles, California; New Orleans, Louisiana; and New York, New York.

Of special interest to the major commercial airlines is the joint FAA/USAF Flight Test Program. This program is a joint effort to develop and evaluate MLS instrument and approach procedures for Category D aircraft including long haul commercial air carriers, strategic airlift aircraft and strategic bombers.

In a similar fashion, we are planning to conduct a user program to demonstrate the advantages of MLS in an operational environment. This program differs from the STEP program mentioned earlier in that the ground systems will be production equipment built to FAA's specifications. The FAA's Eastern and New England Regions are cooperating in planning this effort and have interested two potential users: Eastern Airlines and Peoples Express. Eastern plans to use two of its A-300 aircraft which will provide additional input for the development of standards and procedures for wide-bodied aircraft and Peoples Express plans to utilize five of its

aircraft in the program. The locations which would provide benefits to these users include LaGuardia, New York; Boston, Massachusetts; and Newark, New Jersey.

While these programs focus primarily on commercial users operating large aircraft, a similar project that emphasizes general aviation participation is planned for Richmond, Virginia, in 1985. An MLS ground station will be installed on runway 02. It is intended that 20 to 30 MLS airborne receivers will be loaned to various persons who operate into the Richmond airport to demonstrate the advantages of MLS to this significant segment of the community.

Lastly, the FAA program provides for the overall management and implementation of MLS within the entire United States. This includes satisfying Department of Defense (DOD) requirements. In addition to the 1250 civil MLS systems, 326 MLS ground stations will be procured under the FAA contract to meet military needs. DOD will implement MLS at a pace consistent with the civil sector and has designated the U.S. Air Force as the lead service for DOD implementation.

MLS is moving into the implementation phase and will introduce a new era in the capabilities for approach and landing. The underlying goal of providing an all-weather capability for essentially all IFR-equipped airports is now within reach and

by the end of the decade all-weather operations should become routine. MLS has all of the essential features necessary to support the goals of the NAS Plan for safety, capacity, productivity, and economy in the approach and landing function, and to support the growth of aviation well into the next century.

Before closing, let me briefly touch on the subject of RNAV. RNAV is a method of establishing points of reference for pilots. In some cases, navigation aids such as VORs are used to supply a signal to update the receiver. This is accomplished by airborne RNAV equipment which sets these points in terms of distance and degrees from the VOR. Thus, an approach to a STOL runway, for example, can be designed with waypoints to guide the pilot to turn or descend without guidance from air traffic control. Because the aircraft can utilize a stub runway, which is different from the runway used by conventional traffic, in some cases it is possible to design an approach which does not mix with the stream of conventional traffic, thus alleviating controller workload. RNAV can also be used in conjunction with MLS.

As I mentioned earlier, at Washington National, we have been utilizing an RNAV/STOL and an RNAV/MLS/STOL approach on a test basis since October 1983. This has been a successful demonstration of the combination of these technologies and procedures and FAA is continuing to examine further means of

refining these techniques to see if they can be applied to other environments. We will be pleased to keep the Subcommittee advised of the results of our efforts in these areas.

It is clear that STOL, MLS, and RNAV can all play a role in increasing the future capacity of our Nation's existing airport structure, but they do not represent a panacea that will solve future capacity problems. We must continue to develop and refine our ATC procedures and technology, and importantly to foster the development of additional runway capacity.

That completes my prepared statement. We would be pleased to respond to your questions now.

Mr. GLICKMAN. Thank you for the cooperation in keeping your statement brief.

You state that it is—in your statement—that it is clear that STOL, MLS and RNAV can play a role in increasing future capacity of our Nation's existing airport structure. Really, you've been making that identical statement—"you" meaning the FAA—for a long time, 20 years, in the 1960's until the present time.

I think industry and users have also been trying to make that happen and I think in the general proposition, Congress has been supportive with funding levels. I guess my concern is that, is there very much progress actually occurring in all of this technology?

Mr. KERN. Let me start and address each of the three different programs and then let Will and Marty get more into it here. From the picture of the national airspace system as a whole, I mentioned that we already have 347 public use RNAV procedures and I would say that that in itself shows that the FAA's been cooperative and probably in the last 10 years, has allowed aircraft operators and people to safely depart and land airports that otherwise they may not have been able to operate out of so I think that says that there has been an incremental gain in capacity to the system.

The MLS program, on the other hand, as I mentioned, will equip 1,250 runway ends with the precision system that is as precise as our category 2 and category 3 landing systems that we have using the instrument landing system today.

So in effect, we will have a very precise navigation system that will allow those kinds of operations to 1,250 airports. So, from the total system capacity of the United States, there's bound to be an increment of capacity improvement.

The STOL operations, on the other hand—I'll have to divide them into the short takeoff and short landing kinds of capabilities

versus the steep approach and departure. Let me talk about this steep approach and departure capability first of all.

There are airports and runways in the United States that are capacity-limited because of obstacles, mountains, tall towers and other physical features. Valdez, AK, was mentioned earlier. There is right now a microwave landing system with a STOL MLS procedure that provides for not only steep approach, but the unique thing at Valdez is the capability of the DHC7 to fly a missed approach out of almost a boxlike canyon. So it has to—the aircraft has to be able to utilize its climb gradient and turn capabilities to get out of there.

The FAA has developed criteria, and as I said, there is an operational procedure today. I think the other case, where we're using the short ends and stubs of runways and aircraft that are specifically designated as STOL runways, again, is in effect. I have a list of all the airports and runways in the United States that are designated as a STOL and it's a substantial list.

Now let me ask Will if he wants to——

Mr. REAZIN. Well, I think the—there's no question of what has been done and have we had any gains. I refer to what the ALPA representative testified about on the closely spaced parallels, on the things that the AOCI Committee has—has worked on.

One of the problems that we—that we face when we start to use the stub runways or intersecting runways is what to do and how to protect that safety during inclement weather, IFR weather, because you have to protect for the missed approach.

We've been using this—this technique of using intersecting runways at practically—well, all of the runways that have intersecting runways for years for those aircraft like John said that had the capability of landing short.

The introduction of MLS in our opinion, is going to provide that precision guidance on the departure or on the missed approach that's going to give us the capability to work toward simultaneous converging approaches. That's one of the recommendations that the task group that John O'Brien referred to, that we are gathering data trying to see how we're going to implement a test for it.

We have already gathered data and intend to implement a test for closely spaced parallels down at Memphis this fall. We have, also studying with the techniques that we gain from that kind of a—of a test, see how we can run simultaneous to triple runways. And so we're working on all of those concepts with the AOCI to continue to gain capacity while maintaining that high level of safety that we must.

Mr. GLICKMAN. Marty, do you have anything to add?

Mr. POZESKY. Well, Mr. Chairman, I can talk a little bit in this area on how we're doing with MLS, and I think our thoughts on the MLS program, and I think with your permission, probably in the context of the hearing, it does make a little—does make some sense in continuity to address the MLS situation now, and if that's with your permission, I'll——

Mr. GLICKMAN. Go ahead.

Mr. POZESKY [continuing]. Try to do that.

First, let me say that clearly we are very committed as an agency and this committee has been very supportive of the MLS

development and the MLS implementation and we are fully committed to that objective. We're marching, I think, with fair speed and reasonable amount of progress toward that objective.

Let me—let me also observe that—that in this particular program, and there are others of this category, we really are reaching a point where some very, very difficult decisions have to be made and the decisions are really how many more ILS's to buy, if any, and we have taken a position that we would not do that in the future. Where to put these MLS's. We have a contract at the Hazeltine Corp. for 208 MLS's and there is some controversy on where to put them and I'd like to just go down in as reasoned a way as I can and go through the history that I think we are looking at in going on with this program, and then describe as briefly as I can what we're trying to do to adjust our approach to meet Mr. Warner's and the general aviation's, and indeed, anybody else's concerns can be accommodated.

No. 1 is clearly, we spend a great—I'd like to mention, we spent a great deal of effort on this transition plan, how to implement MLS and where it was in the hub-and-spoke concept and we went out with public hearings and we went through the public register and we, in a very, very formal way, published a transition plan which outlined the strategy for MLS implementation which we felt captured most of the interests and the endorsement of the user community.

It talks for colocation of MLS on ILS runways to certain extent. It establishes a policy that, to the extent that that colocation occurs, we will not decommission an ILS in any less than 2 , nor more than 10 years after MLS is colocated, so we do have a strategy that recognizes that MLS and ILS will have to cooperate on runway ends for a reasonable transition period of time. We're still very much on that cost—that course.

The cost issue was mentioned, avionics as well as ground equipment. I guess I'm happy to report that the contract—we do have a contract with the Hazeltine Corp. and the costs for MLS are—in that contract are around $650,000 per system, and I'd add about half that cost is the hardware itself. The other half of that cost are things like factory inspection, provisioning, regional costs associated with the installation of that equipment, sparing costs, support costs, et cetera.

I'd just like to juggle a few numbers and say that that cost compares very favorably to earlier estimates of small community costs that I know this committee has been in—has been interested in, that we did have—RTCA did an estimate of SC 125 back in 1975 on MLS costs for the small community and these costs that we have compare very favorably with that.

AVIONICS COSTS

Yes, today's market is $10,000 to $12,000. I think that Mr. Quinby stated it correctly. I think that—that the marketplace will drive those costs. Some baselines perhaps are appropriate. We bought MLS avionics for our test program using brand new microchip technology at about $8,000 a system in the development program. We've done studies with ARINC and we fully believe that we

can realize—we'll ultimately realize that $2,000 or $2,500 cost market in 1983 dollars, again, for MLS avionics costs, but clearly, that's got to be a supplier decision and a marketplace decision.

The location of MLS is important. We are—we fully recognize—we are trying to work with the community to get the best balance of locations. We do have the 208 MLS's ordered per the transition plan philosophy. We are trying to work with the community as best we can to revalidate those locations. That process is ongoing.

Right now, the official answer is we do have—we can—there is a contract and there are 208 locations identified in that contract, but we are trying as best we can to revalidate that with the community interests.

To try to summarize, I think that we recognize—we are fully committed to MLS. We're trying to accelerate the rate at which we're installing MLS. We're looking at that. We understand that getting over this transition is extremely—is an extremely critical point in the implementation of this system and we're really trying as best we can to work with the community.

I'll try—try to answer any other question you may have along that regard.

Mr. GLICKMAN. Well, I just make one question: What about the AOPA comment that satellite technology is going to come along and just render useless and outdate the MLS/RNAV technology?

Mr. POZESKY. We've taken a critical look at that. We constantly keep our eye out on it. We don't believe that the satellite technology is going to reach that level of maturity for, you know, for the timeframe of the MLS or certainly the timeframe of the NAS plan.

We are posturing ourselves to accommodate global positioning systems and any other use of technology in a supplemental basis, but we've done the same kinds of studies, I think, that have been—that I know have been reported to you and we've looked at it in the future. We do not see a serious competition in the timeframe we're talking about.

Mr. GLICKMAN. But you're not discouraging satellite technology as a way to kind of buttress what you're doing now?

Mr. POZESKY. Absolutely not. We're trying—as I say, we're encouraging it. We are trying to posture ourselves and believe we have to accommodate it when it comes onboard, online.

Mr. GLICKMAN. Mr. Kern, have you yourself, in the last few months, been victimized by traffic delays at major airports? Any of you?

Mr. KERN. Yes, sir.

Mr. GLICKMAN. You have.

Mr. REAZIN. Yes, sir.

Mr. POZESKY. Yes, sir.

Mr. KERN. I think we all have.

Mr. GLICKMAN. OK, just wanted to make sure that it's happened to you. [Laughter.]

Mr. KERN. Even in FAA aircraft, sir.

Mr. GLICKMAN. Pardon?

Mr. KERN. Even when we're flying FAA aircraft.

Mr. GLICKMAN. But also in commercial aircraft——

Mr. KERN. Yes, sir.

Mr. GLICKMAN [continuing]. This has happened. OK.

Mr. Carney.

Mr. CARNEY. Thank you.

Mr. Kern, there's a common theme through much of the testimony that there's an inherent resistance within the FAA to move along on new technology. We heard it today. I think Mr. Ransome was saying that that resistance is there and it's also difficult for the users to—to touch someone in the FAA who would honcho, quote, unquote, the new technology.

We've heard that time and time again in this committee and I was wondering if you are looking at ways where the FAA can move on new technology in a shorter window of time and deal with the users, the agencies, deal with the users on new technology and improve that?

Mr. KERN. Well, I can appreciate Mr. Ransome's comment. In fact, I'd like to compliment he and his corporation for the time really they spent with us in FAA in the past few years, when we needed a commuter, when we needed somebody to step forward and help the FAA, so to speak, in some of our developing programs, such as the one at National Airport, he stepped forward and it certainly has cost his corporation a number of dollars.

I think he and others have better explained it. You know, the technological improvements we're seeing happening today right at National Airport and others in the country are—are moving very rapidly. The kinds of communications and navigation systems that we see on a daily basis are moving at a very rapid pace and I would—although I wasn't part of it in the 1950's and 1960's, I would imagine that it was very stable and things. We had more time to consider these things. Maybe not, but anyway, I believe that the cooperation that FAA and Ransome and other—the rest of the industry have demonstrated throughout a program as innovative as the one that we're talking about at National Airport—and it is a significant program. We're talking about not only navigation systems; we're talking about air traffic procedures and criteria, operational criteria and training programs, certification of aircraft, the whole capacity issue and a number of things that are very complex.

Let me—nobody mentioned earlier, but I would like to say that the procedure that Ransome has been using at National Airport, up until this point, has been basically a visual procedure. In other words, the minima that we've allowed Ransome to use up until this point is 1,500. The ceiling has to be at least 1,500 feet so the pilot can see and land on the runway and see it from the time he's at 1,500 feet.

We're at the point in this development program—and as I say, it has been a very, I think, well thought out, conservative program that deals with the issues as they come along. We're at the point in that program right now where we and the industry have to decide where we're going to step those minima down and somebody alluded to the fact earlier, we're now talking about instrument procedures and instrument arrivals, and those are the moneymakers when you get into the capacity issue.

We have worked with Ransome to develop a procedure and I think in my experience in FAA that the timing really hasn't been that bad. We have a task force that has been working directly

with—with the commuter industry. We have a task forces that's working with AOCI and others to consider all the capacity improvements, and to get back to the Ransome situation, there has been a new procedure developed and the proper people within the agency who have the authority to make the handbook changes and the criteria changes and the decisions whether to implement are active and they're working on that procedure today.

I thought—from a timing standpoint, I don't think your hearing could have been any better timed because it is a critical time in that development for us and—and we're all hopeful that this time next year, if we're sitting around the table, these kinds of operations will be more common and we won't have some of the same kinds of questions we had today, but I—I caught from the testimony of many of the people that they seem to be satisfied with the cooperation with the FAA and I know that the people in the air traffic service and the research and development side of the house and my own side, the flight operational side, have put a lot of time on it.

ALPA has put a lot of time on it. NBAA has put a lot of time on it and all the interested people who normally get involved in these kinds of criteria development. I think we're fairly well on course in that area.

Mr. CARNEY. I hope you don't misunderstand me. I'm a fan of FAA, but that's not the way I read the testimony. That's not the way I listened to the folks out there.

Mr. KERN. Maybe I just heard what I wanted to hear. [Laughter.]

Mr. CARNEY. You did a marvelous job of summarizing your testimony and you did a marvelous job of punting on that question, too. [Laughter.]

You're a good bureaucrat. [Laughter.]

I yield back the balance of my time.

Thank you, Mr. Chairman.

Mr. GLICKMAN. Mr. McCandless.

Mr. MCCANDLESS. Thank you, Mr. Chairman.

Mr. Kern, very briefly, in our previous testimony, you talked about the user fees that I believe are in a trust fund in the amount of something like $3 billion, which certainly is a nice thing to have in an agency such as you represent in order to further the cause of that particular source and make it more agreeable, more desirable for the individuals to travel.

Are you satisfied that the FAA is doing everything it can, because of the fact that it does have this resource with that resource to smooth out the bumps in the system, to plan what's necessary and then work the plan and see it through?

The general—the reason for asking this is, the general assessment in the limited time I've been here—but I came from another level of government—is that the FAA reacts rather than acts and that's why I'm asking you this question.

Mr. KERN. I've heard that accusation before and I think we all have in the room here, and I think there is——

Mr. MCCANDLESS. You see, you've got—you've got a wallet here that your people who are utilizing what it is you're responsible for, are paying you to keep on top of, which is a little different from some of the places down the street and up the street——

Mr. KERN. I understand.

Mr. MCCANDLESS. And that's the concern I have.

Mr. KERN. I—well, the agency basically uses that money for three different—for three different uses. We do offer grants to airports and communities to improve the safety of their navigation facilities in their airports and runways and other——

Mr. MCCANDLESS. I'm very appreciative of that and I've been a recipient of that in my area. Thank you.

Mr. KERN. The other part of it is, of course, for our research and development program that supports the kinds of activities that we're talking about today and others that we've talked about here in this room.

I guess from the planning standpoint, I'd have to say that in the last few years, with the advent of the national airspace system plan and the other kinds of planning activities that the agency's undertaken, one of the—I think the main thrust of that was to try to get ahead of this power curve for once, to try to put down in one document those many, many projects that—and programs—that heretofore had been piecemeal and independent kinds of projects into one document that this committee and others can—can review and approve.

I don't know that we'll ever get to the point where we've thought of every question before it's asked. It seems—and before I was in flight operations, I was in aviation safety part of the FAA, specifically the Office of Aviation Safety—and it seemed that the issues that we talked about with the NTSB and others were almost the random kind of issues that it would be very difficult for anybody to predict. And I think every time that happens, of course, the press and the others look at the FAA and say, "Well, why didn't you think about that? Why didn't you do something about that?"

Mr. MCCANDLESS. Well, today we've heard some very interesting testimony from some very knowledgeable people. In my limited ability, I would summarize it by saying a lot of it has to do with—well, when these particular types of planes come on-line, when these particular types of navigational instruments are available, when these particular flight systems are a part of the status quo, then all this will flow together and we'll have a much smoother operation. But the problem is one of that's all good in theory, but how many years are going to transpire before all of these pieces fall into place?

You know, if you can get past Park Place and Boardwalk with a hotel on it, you get 200 bucks, and if you land on Mediterranean, it isn't quite as much money, but we're now—we're now headed for Park Place and Boardwalk with hotels on them and—if you play Monopoly—[Laughter.]

And the situation there is one of you're wiped out, you know. You wait 30 minutes today or 20 minutes today, unless there's something injected into the system, it may be an hour 2 years from now or whatever the time frame involved, and that's a concern that the average person has that rides these planes, whether it be my colleague from Wichita or the one up from New York, wherever that place is up there where they have all the problems. [Laughter.]

Mr. CARNEY. No, that's New York where Ransome flies and uses the stub runway and I'm never delayed. [Laughter.]

Mr. MCCANDLESS. Just got a lifetime pass for Ransome. [Laughter.]

That's a concern I have and that's why I was asking the question I was asking. Are we trying to take what we have today and do with it what we can, rather than wait for that 10-year time place down the line when all of this is going to happen; in the meantime, total chaos take place?

Mr. KERN. Well, I think—I think we're really doing both. You know, we talked an awful lot about the attributes of the—of the microwave landing system today. As an example, in the past few years, there have been improvements to the instrument landing system. That's not very popular for me to say, but there have been some incremental improvements. I think that the Air Traffic Service has been trying to—to deal with their own computer situation to make sure it is able to deal with the traffic that we have right now in lieu of a replacement system that's down the road.

I think one of the—to me, anyway—one of the benefits of our national airspace system plan was we clearly recognized that—that the greatest hinderance to capacity is the runway and concrete situation and it's stated right there in the book, and we also are now coming around to the opinion that maybe it just isn't the FAA that's a contributor; maybe it's some of the scheduling of the airlines that contribute to the delay problem.

So I think the facts of the—of the aviation system are—are more available today and people are being more realistic about what really is causing some of these delays.

Mr. MCCANDLESS. Your answer to my question is yes, you think you're doing all that's necessary with the resources that you have, my user fees, to keep on top of this situation.

Mr. KERN. I'm really not sure what more we could do. You know, one of the reasons I think that Mr. Helms appointed the Task Force on Runway Capacity was to ask the community what could be done in that area if we're talking about the capacity arena.

Mr. POZESKY. Let me——

Mr. KERN. Go ahead.

Mr. POZESKY. Yeah, if I could get the very—chance for a second to wax a little philosophical, I think there are a couple of observations we need to make. I would second the notion that, yes, within the constraints that—that—that are real, as much as the—the FAA is doing as much as reasonably—as it reasonably can. You know, you can always fine-tune an act; you can always improve its efficiency 5 percent or 10 percent, but let me give you certain examples of what I'm talking about.

I'm from the side of the business that's involved in the air traffic control arena and the computers and the facilities that operate the system. We try very, very hard to deal with a very diverse set of customers. We've recently come up with a plan which, in the first time in my memory, it really represents a national consensus on how to modernize that system. It was a plan which this committee, as you well know, was very instrumental in supporting.

The time frames we deal with on major changes are very, very large. Microwave landing system: 20 years. Mode system: probably

equal length of time. The computer systems that we have today that we're trying to modernize: 20 years. So we've really—from the facilities' point of view, really are not able to implement national systems of broad scope in time frames of a year or two or three. It takes—for the technical facilities we're talking about—it takes that kind of time frame and the kind of planning we do and the course we're on, I think does deal as best we can with the future of the problem—with the problems of the future.

The day-to-day—the problems that we have today, the capacity problems, well, this committee's already identified that the FAA can only do a limited—certain amount of that. Some of these changes have to be left to the airlines and have to be left as part of their—their reasonable judgment in this process.

I—I—I would have to say that I'm not sure that there is really anything that—while it's always popular to say that the FAA or the Federal Government is not doing enough, I am really hard-pressed to understand what reasonably more could be done with the application of the additional dollars that are in the trust fund. I don't see—it doesn't pop out at me.

Mr. MCCANDLESS. Thank you, gentlemen.

Thank you, Mr. Chairman.

Mr. GLICKMAN. Thank you.

Mr. Carney, you had a final comment?

Mr. CARNEY. Oh, I would just like to say, along Marty's lines, is that, you know, we are going through a complete change and it is expensive and I kind of agree with what you're saying on getting the best for our dollar and I—I commend you for the job that you're doing in all honesty, and I couldn't help but finish that off by saying that the product that you buy is a good product. It's built in my home town—[Laughter.]

So I'll congratulate Mr. Miller on that. Thank you. That's Long Island, by the way, you Know. [Laughter.]

Mr. MCCANDLESS. How do you say that again, "Lon Giland?".

Mr. CARNEY. Long Island.

Mr. MCCANDLESS. Long Island.

Mr. CARNEY. Right. We have good aircraft service——

Mr. GLICKMAN. Is this——

Mr. CARNEY. We make a fine product.

Mr. GLICKMAN. Is that where the next Vice President of the United States is coming from, by any—is that Long Island?

Mr. CARNEY. No; I think George Bush is from Texas.

Mr. GLICKMAN. Oh, OK. [Laughter.]

We want to thank you all for your testimony.

Tomorrow at 9:30, we will have a hearing in room 2318 on the issue of wind shear and without any further remarks, the hearing is adjourned.

[Whereupon, at 12:45 p.m., the subcommittee was adjourned, to reconvene at 9:30 a.m., Wednesday, July 25, 1984.]

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